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OF THE

NATIONAL FIRE PROTECTION ASSOCIATION

"To Promote the Science and Improve the Methods of Fire Protection and Prevention."

PUBLISHED QUARTERLY AT BOSTON, MASS., BY THE
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Vol. 35 October, 1941 No. 2

QUARTERLY

OF THE

National Fire Protection Association

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National Fire Protection Association

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A NON-PROFIT TECHNICAL AND EDUCATIONAL ORGANIZATION

To promote the science and improve the methods of fire protection and prevention.

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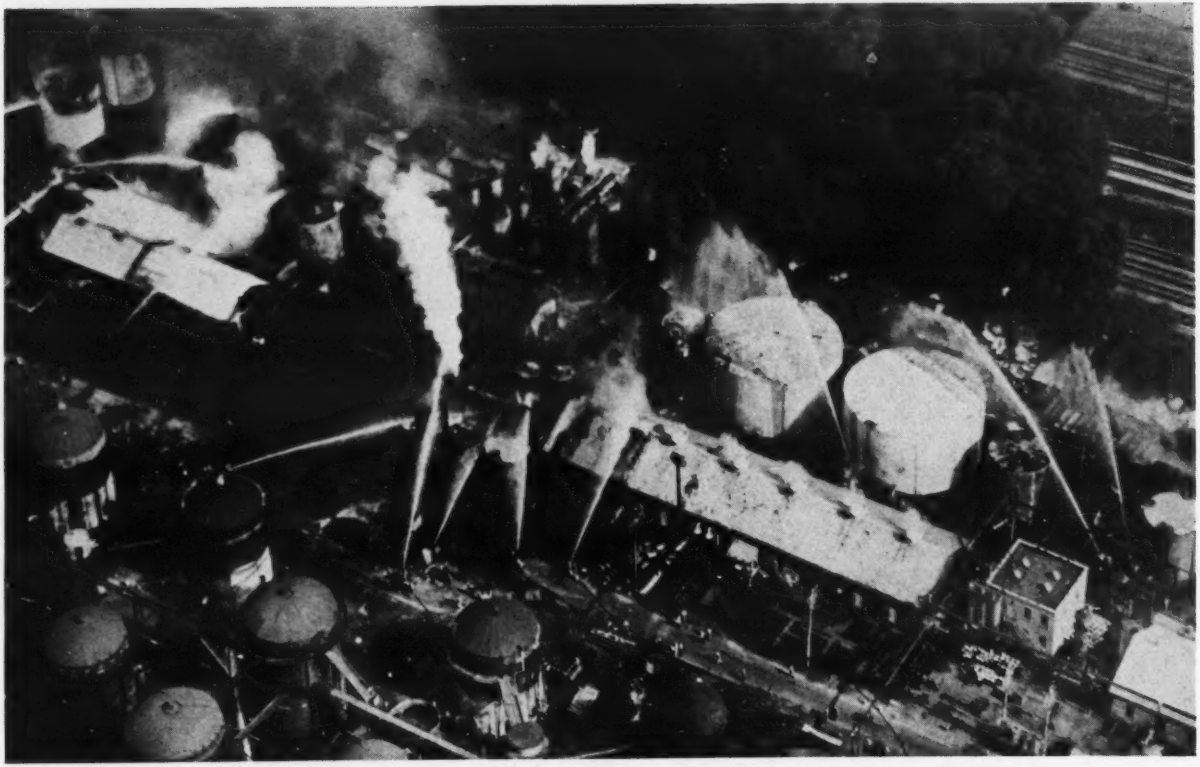
Reports of fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.



Acme.

The world's largest refinery, that of the Standard Oil Company of Indiana in Whiting, covering more than 770 acres, suffered a nine-hour fire on Sept. 24, which destroyed some thirty tanks and a half dozen buildings. This plant is engaged in the manufacture of a vitally important defense commodity, aviation gasoline. Once again fire hinders defense. One man was killed. (See page 176.)

The Quarterly

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Fire and War. The importance of fire defense to a nation at war or a nation preparing for war is self-evident. Although the term itself came into being following the incendiary bomb attack on English cities by the Germans, Fire Defense has now come to have a far wider meaning than that of a mere defense against incendiary bomb attacks. In little more than a year, Fire Defense has come to be almost synonymous with fire protection: any fire is a hindrance to either defense or war efforts. To defend against fire means that the defense must be maintained everywhere throughout the nation.

Fire defense has three separate aspects: protection against fire, accidental or due to sabotage, for military establishments and for manufacturing facilities for military equipment such as airplanes; protection against fires due to possible incendiary bombing; and general protection for homes, commercial buildings, manufactured goods and foodstuffs where any fire loss has an indirect if not a direct effect on the national defense program. The same protection facilities are to some extent applicable to all three subdivisions of fire defense, but the problems are essentially different. Thus far, the primary emphasis has been placed upon the first phase, protection of Army and Navy property and plants manufacturing military equipment of primary importance. While there still remains much to do in this division of fire defense, the progress to date in this field has been considerable. The deficiencies that remain are due largely to ignorance of what constitutes proper protection rather than to any lack of good intentions.

The second phase, protection against fire due to incendiary bombing, is receiving national attention. The only material progress to date is in plans for organization and training of personnel. Equipment for such protection is available only on a small scale except in so far as ordinary peacetime equipment may be used. Plans are being made for the U. S. Government to supply certain auxiliary equipment for fire department use, but the much greater problem of making equipment available for protection of individual properties has received little attention. The anachronism of elaborate organization plans for auxiliary firemen but very limited fire protection equipment may be explained by differences in opinion as to the need for protection against incendiary bombing. Everyone agrees that American cities would be generally vulnerable

of a vitally important defense commodity, aviation gasoline. Once again fire hinders defense. One man was killed. (See page 176.)

to incendiary bomb attack and this stimulates organization of personnel to meet this threat. On the other hand, many authorities feel that there is no immediate possibility of any large scale attack by enemy bombers and this explains why metals and other scarce materials are not made available for general fire protection uses. Even without added equipment, however, the training program is well worth while, for with the proper organization and training much can be done to meet the potential menace of incendiary bombing with a minimum of additional equipment.

The third phase of fire defense, that of general protection for all buildings, commodities and facilities, has received relatively little attention except at the hands of fire protection authorities, who appreciate the importance of preventing all unnecessary loss by fire. The general public does not in the least appreciate the cumulative effect of individually unimportant fires upon the defense program. General protection is being improved by increased activity on the part of fire departments and other fire protection authorities, but obsolescent fire fighting equipment is not being replaced, and from the point of view of equipment, general protection is gradually deteriorating. This potentially is most serious. The fire losses in recent months have already shown a decided upward trend. This might perhaps be expected in a period of increased manufacturing activity, but it indicates the need for better protection.

* * * * *

Priorities. Industries engaged in the manufacture of fire protection equipment and apparatus report that 70 to 90 per cent of their products are now going to the Army, Navy or directly to munitions plants. Priority regulations which restrict the supply of vital metals and other commodities to uses having the highest priority ratings tend increasingly to restrict fire equipment deliveries to military and defense plant uses. Until recently, the situation has not been critical owing to the availability of reserve stocks of equipment or metals and other materials used for the manufacture of fire equipment. However, if present conditions continue, practically no new fire protection equipment will be available for ordinary civilian uses. This includes automatic sprinklers, fire extinguishers, fire alarm equipment, fire apparatus, tanks and piping for fire protection and other items. Fire protection equipment for municipal and general use has, to be sure, been given an intermediate priority rating in recognition of its importance. However, manufacturers report that materials needed in the manufacture of equipment are currently available only for the highest of the priority ratings, and that the necessary materials cannot be obtained under the intermediate rating for general fire protection. The situation seems critical, because when present stocks are exhausted it appears that materials may not be available even for ordinary

repairs and replacements. The fire protection fraternity should, of course, recognize the importance of the present war effort and should be willing, like others, to make sacrifices for the national good. It is, however, hard for some N.F.P.A. members to understand why fire protection materials should be so restricted in view of the fact that fire is one of the major weapons of modern warfare and fire defense is most important to national defense.

One interesting aspect of the priority situation is the government control currently exercised over types of fire protection products. For example, a recent communication from the Office of Production Management to each manufacturer of motorized fire apparatus requests them not to manufacture certain special types of apparatus, such as quintuple combination ladder trucks, and squad and salvage cars; also to limit pumpers to the standard ratings of 500, 600, 750, 1000 and 1250 gallons per minute. Another restriction in the same communication excludes forest fire trucks, crash trucks or booster tank trucks having a tank capacity exceeding 500 gallons, and also restricts the pumping capacity of such apparatus to 400 gallons per minute, thus prohibiting the use of the same piece of apparatus as a water tank truck and a pumper. In so far as such restrictions serve to concentrate the limited facilities of apparatus manufacturers upon the protection of the well-recognized standard types, the effect will presumably be beneficial, and it does not seem that changes such as the prohibition of bells on fire trucks will have any important effect upon fire fighting efficiency. Such regulations, however, must be intelligently administered by men fully familiar with fire protection problems in order to avoid rules that may hamper the most efficient development of fire protection.

* * * * *

Substitutes. With the restricted supply of bronze, brass, aluminum and other materials that have been used for fire apparatus, extinguishers and other fire protection equipment, plans are under way for extensive substitutions of less critical materials. Extinguishers with steel shells instead of copper, malleable iron hose couplings in place of brass, iron parts in place of bronze or brass in certain sprinkler equipment, and many other changes in design have been proposed and to some extent already put into effect. Great care must be taken in any such substitutions to be sure that the efficiency and reliability of the equipment will not be sacrificed. Unlike many items of equipment in daily use where an occasional failure may mean nothing more than some temporary inconvenience, any failure of fire protection equipment may have most disastrous consequences. The highest degree of reliability is accordingly essential. It is most sincerely to be hoped that this will be kept fully in mind in all plans for the use of substitute materials. A very real danger in the use of substitutes is that while the substitute, when new, may

serve just as well as the original material, it may have a shorter life and may involve maintenance difficulties. Take for example the proposed use of iron instead of brass for hose couplings. Iron couplings can be made to be just as strong as brass. However, iron rusts unless protected. The natural tendency would be to apply oil to the couplings liberally to prevent rust just as would be done for the protection of any iron machine part. Oil, however, causes the rapid deterioration of rubber hose and great care would have to be taken to oil iron couplings sufficiently to prevent rusting and at the same time not get oil on the hose.

In addition to changes in the specialized field of fire protection equipment, substitutions involve many possibilities of increased hazards which must be considered by the fire protection fraternity. The danger is that substitutions may not be made intelligently with full knowledge of all the factors involved. For example, a Supplies Priority Allocation Board message from Washington suggests that state and city building codes be suspended during the emergency where they require the use of excessive amounts of critical materials. This seems very questionable advice, for if materials are not available to construct a building safely it may be better not to build it at all.

* * * * *

Sabotage. Among the large fires which have occurred during the present emergency period, no case has as yet come to the attention of the N.F.P.A. Executive Office where any major fire loss has been proved to be due to sabotage. Efforts of Federal and local authorities towards the prevention of sabotage are, of course, essential, as sabotage by fire is one of the easiest methods available to the foreign agent intent upon malicious destruction. Sabotage, however, seems to be overemphasized in its relation to other possible fire causes, and the authorities concerned with the investigation of possible sabotage all too often seem oblivious of other possible fire causes and fail to appreciate the fact that a fire started by a carelessly discarded cigarette may be just as disastrous as a fire started in the same place by a saboteur. The original cause of fire is often relatively unimportant; what is really important is the reason a small fire spreads to cause a large loss. After practically every major fire of recent date, the cry of sabotage has been raised. This often serves only to distract attention from the fundamental needs of protection. Any important plant for storage of vital materials should be arranged and protected so as to prevent the possibility of any major fire from any cause, sabotage or accident. Fences and guards are desirable, but they do not necessarily prevent the start of fire, which may originate from any one of a thousand causes. The real answer is, of course, subdivision of values to restrict the amount subject to a single fire from any cause and adequate protection for each individual area.

Type S Fuses. For years the bridging of fuses by putting pennies in fuse holders under burned-out fuses or by the use of wires or other expedients has been a constant source of concern to fire protection and electrical inspectors. Fires in large number have been caused by such tampering. Despite active educational efforts by many N.F.P.A. members and cooperating organizations, large sections of the public apparently still do not realize that the fuse is the safety valve of the electric circuit, placed there for the protection of the occupants of the building. While the cumulative effect of educational efforts as to the importance of fuses has doubtless been a material factor in reducing the frequency of bridging fuses, the practice unfortunately has generally continued up to the present time. Apparently the immediate use of electric service for lights or for the operation of appliances is of such paramount importance to the householder that in his haste to restore electric service interrupted by a blown fuse he forgets the function of the fuse and is oblivious of the probable consquences of his tampering.

The seriousness of this problem has been realized by electrical inspectors for many years and has been the subject of extended consideration in the N.F.P.A. Electrical Committee, which has jurisdiction over the National Electrical Code. First proposals were made for code provisions requiring "non-tamperable" fuses, but these proposals were later modified to "tamper resisting" and later to "Type S" when it appeared that no practical fuse design was actually proof against the attack of the home mechanic armed with a few tools. If the bridging of a fuse can be made sufficiently difficult for the home mechanic so that he will have an incentive for keeping a supply of proper fuses on hand and seeing that the source of the trouble is corrected when a fuse blows, the main object of the committee will be accomplished.

There have been several designs of "tamper resisting" fuses proposed which have been shown by laboratory test to be reasonably satisfactory. Practical difficulties arose, however, when it appeared that provisions in the National Electrical Code for "tamper resisting" fuses might result in the introduction of a considerable variety of non-interchangeable fuse types which would vastly complicate the problems of the public utility companies and others servicing electrical equipment. It accordingly appeared to the committee that any new requirement for fuses should aim at the introduction of interchangeable fuses so that there would be no complication or lack of interchangeability between the products of different manufacturers. Further progress seemed blocked, however, when it appeared that various designs of "non-tamperable" fuses had been patented by individual manufacturers and it would be contrary to Association policy to adopt any requirement calling for the exclusive use of a patented article not freely available to all.

The Electrical Committee at their meeting held last June finally agreed upon a standard design, adopting the dimensions of a patented type of "tamper resisting" fuse, but only after suitable agreement had been made by the manufacturer to release the patent for general use without royalty. Subsequently the N.F.P.A. Board of Directors has taken official action confirming this agreement, and the officers of the Association have signed an agreement with the McGraw Electric Company whereby the new Type S fuse standard covered by the company's patents will be made freely available without royalty to all manufacturers who desire to manufacture Type S fuses to comply with the National Electrical Code.

This action represents great progress toward the reduction of electrical fire hazards. The new requirement for Type S fuses will, to be sure, apply only to new installations, and the existing types of plug fuses will continue to be used on existing equipments. However, as new electrical installations are made and old installations rewired, the new type of fuse will come into general use. It also may be expected that there will be considerable voluntary conversion to the new type, as adapters are available which can be screwed into the old type fuse holders to make them take the new type of fuse. The Type S fuse not only reduces the danger of tampering, but has the added desirable feature of limiting the improper use of oversize fuses. Under the new design, fuses of a rating greater than 15 amperes cannot be inserted in the fuse holders of 15 ampere circuits. The dimensions of the fuse holder for circuits of 15-30 amperes are sufficiently different so that the fuses are not interchangeable, but the fuses of the lower ampere ratings can, if desired, be used in the 15-30 ampere holders.

The Fire Fighters of London in Action.

N.F.P.A. members will long remember the contribution of Lewis Partington to the 1941 Annual Meeting in Toronto — his first-hand account of fighting blitz fires. Here was a man who had been "baptized by fire," who had fought against the Nazi Luftwaffe as a fireman.

Now, with the Luftwaffe's wings turned eastward, other auxiliary firemen have had a chance to put aside their hose and pumpers temporarily . . . to reflect on what has happened, what they have been doing. The result of these reflections is *The Fire Fighters of London in Action,* a book written and illustrated by London's Auxiliary Firemen.

The book starts with September 7, 1940, and the raids on London that followed for the next three months. But these raids, with all of their ferocity, with all of their destruction, now seem as merely preparatory and good training for the great raid of Sunday night, December 29th.

That night the Nazis deluged London with a downpour of 100,000 incendiary bombs of all sizes and types. For the first time since the Great Fire of 1666 there was fear for the city's safety. Tremendous conflagrations raged and 25,000 fire fighters of the auxiliary fire service fought all through that night and the next day. When all was over 14 firemen had been killed, 250 had been injured, to say nothing of the civilian casualties. On New Year's eve "Great blocks of buildings had been gutted to the ground. The charred shells of burnt-out shops and offices lined whole streets. Beautiful architecture had disappeared overnight, or now faced the daylight black and broken — pathetic evidence of the new German culture. Historic churches, designed centuries before by the master hand of Christopher Wren, lay shattered, their very altars choked with the black mud of sodden ember and ash. And yet, with all this melancholy toll of destruction the heart of the City, together with its great Cathedral, had been saved."

But even with the breathing spell now offered them, London firemen fight on. "Now, with experience of arson on a titanic scale, the Fire Service is striving to increase its strength and minimize damage in the future. Every day the forces of fire prevention and fire fighting are being augmented and refined, and a big salvage scheme to protect goods against damage by water is beginning to operate."

The auxiliary fire service certainly numbers some very fine artists among its members. On the following pages are two of the illustrations appearing in the book, of which half of the publishing profits are pledged to the London Fire Brigade Benevolent Fund. *The Fire Fighters of London in Action,* by members of the London Fire Brigade. Garden City Publishing Co., Garden City. New York, 1941. 49 pp., illus., 25¢.

SUNDAY, 29TH DECEMBER, 1940. Oil painting by auxiliary fireman PAUL DESSAU. In this dramatic picture Dessau has caught, with absolute truth and without any exaggeration, the scene surrounding St. Paul's on the night of December 29th. In the background may be seen the dome lighted up from the glare of surrounding fires, while a pump's crew can be seen pushing a trailer pump over rubble and debris to take up a fresh position in order to get to work.

It seems incredible that all these fires were out by the morning.

NO. 43 LEE IN ACTION. Water color by auxiliary fireman T. BUTLER. This drawing is of particular interest to students of art considering that it is the second attempt of a fireman who had not previously painted. Its sincerity, intention, and general color scheme are remarkable.

This water color shows two trailer pumps getting to work. The fireman in the left-hand corner is connecting up to a hydrant, and on the right can be seen the coachwork of a London Auxiliary Fire Service tender which is used as a towing vehicle for the pump.

Committee Notes.

Air Conditioning.

Mr. F. H. Faust of the General Electric Co., Bloomfield, N. J., a member of this committee, has been appointed chairman to succeed Carl W. Wheelock of the Association of Fire Underwriters of Baltimore City, who has resigned from the chairmanship but remains a member of the committee.

City Planning and Zoning.

Rudolph P. Miller, member and former chairman of this committee, past president and honorary member of the N.F.P.A., and dean of building code experts, has been practicing engineering since 1888 and is still active in consulting engineering and committee work. He is currently retained to write a new building code for Richmond, Va.

Construction Operations.

Carl G. Richmond of the Associated Factory Mutual Fire Insurance Companies, now Major, Corps of Engineers, Production Branch, Office of the Under Secretary of War, Washington, has been appointed chairman of this committee. The former chairman, William B. White of the New York Board of Fire Underwriters, retired from active work last winter. During the depression years, when relatively few new structures were being erected, this committee was inactive, but with the present volume of defense construction the fire safety of buildings in course of construction is of great importance. Major Richmond has been particularly interested in having fire protection equipment installed at an early stage in the construction of defense plants, rather than deferring fire protection until plants are completed.

Electrical.

Contrary to the usual plan of concentrating committee work in the winter, this committee held a meeting at the Lake Shore Club, Chicago, on June 10 and 11. Forty-nine of the fifty members of the committee were present or represented by alternates. With members, alternates, technical advisers, members of special subcommitees, and representatives of co-operative organizations, the attendance at the meeting averaged around one hundred. Chairman Alvah Small has a well-deserved reputation for conducting large meetings efficiently. After his comment in the first session that no one had ever presented him with a gavel with which to keep order, Contractor George Andrae presented him with an enormous meat cleaver which he wielded as a gavel throughout the balance of the meeting.

The first business of the meeting was adopting new rules of procedure. Decisions in this commitee are often very close. There is a two-thirds rule for

changes in the National Electrical Code, and it seemed desirable to clarify the procedure to prevent any possible future interference with the orderly actions of the committee due to parliamentary technicalities. L. F. Adams of the General Electric Company, reporting as the Chairman of the Committee on Procedure, suggested committee attention to a number of new items, such as special provisions applying to wiring within the fire limits of cities, wiring for circuses and carnivals, farm wiring, temporary wiring for construction, and maintenance of electrical equipment. Mr. Adams' proposals went no further than the appointment of subcommittees to study these subjects, but they were all rejected with little discussion. Apparently the committee feels that the present National Electrical Code is pretty good and does not care to venture into new fields.

The main discussion at the meeting centered around the non-tamperable fuse question, which members will recall has been featured in reports of this committee for many years, particularly in the minority reports and the discussions at the Chicago meeting in 1937. O. K. Coleman, of the American Gas and Electric Service Company, New York, presented a report proposing a special "Type S Fuse," which included as many desirable characteristics as possible without running afoul of existing patents. (See description in April, 1941, QUARTERLY). The committee rejected this, pausing only long enough to thank Mr. Coleman and the committee members associated with him for their efforts, and proceeded to adopt as standard dimensions of a so-called Exhibit A, corresponding to those of a fuse made by the Bussmann Manufacturing Company. This action was taken only after Vice President Bussmann appeared before the meeting and agreed to make his patent available to all manufacturers without royalty. This requirement for the use of an interchangeable and tamper resisting fuse is already in the 1940 edition of the Electrical Code, in effect November 1, 1941, so the action of the committee does not actually modify the code but merely sets up a dimensional requirement. The delegation of the National Electrical Manufacturers Association and the Edison Electric Institute seemed to be somewhat apprehensive of possible legal complications; they, with four other voting representatives, asked to be recorded as not voting.

Frank Thornton of the Westinghouse Electric and Manufacturing Company, Pittsburgh, speaking for the National Electrical Manufacturers Association, presented several motions dealing with correlation between the work of other N.F.P.A. committees which were duly adopted. These motions apparently satisfied the group in the Electrical Committee which seems to feel that no other N.F.P.A. committee should mention electrical equipment in any of its reports without first consulting the Electrical Committee.

Many other matters, including action on simplified wire sizes, tentative interim amendments, and proposed reorganization of Article 300 of the Code, occupied the balance of the busy two-day session. All the members appeared intensively interested and very much on the job.

Firemen's Training.

A new N.F.P.A. Committee on Firemen's Training has been appointed to promote effective training of firemen in co-operation with other agencies, and develop text material for such training. W. Fred Heisler, of the Oklahoma A. & M. College, chairman of this new committee, conferred with other leaders in this field at the Pennsylvania Fire College in August. Mr. Heisler, who spoke before the Volunteer Firemen's Session of the 1941 N.F.P.A. Annual Meeting in Toronto, is a nationally recognized authority in firemen's training. J. W. Just, vice chairman of the committee, is a long time N.F.P.A. member who needs no introduction. Before his present connection with Fire Service Extension in the University of Maryland, he was in similar work in Wisconsin, and before that with inspection bureaus in Michigan and Illinois.

Harold R. Brayton, Professor of Chemistry in the A. and M. College of Texas, long active in firemen's training work, is now Major Brayton in the Chemical Warfare Service, Edgewood Arsenal, Maryland, where he is directing a series of schools for war time fire fighters.

Clarence Goldsmith of the Chicago office of the National Board of Fire Underwriters, chairman of the Fire Service Extension Committee of the National Fire Waste Council, is now a "dollar-a-year" fire protection consultant for the War Department in Washington. Colonel Goldsmith has accepted service on this committee with the comment that this activity is very important at the present time.

Richard E. Vernor, Vice President N.F.P.A., chairman of the Fire Department Instructors Conference held annually in Memphis, has recently been elected a director of Rotary International.

Fireproofing and Preservative Treatments.

Chairman T. R. Truax, Forest Products Laboratory, Madison, Wis., is continuously active in research projects in this field. Last year he demonstrated that much advertised fireproofing treatments for Christmas trees are no better than keeping them moist with water. Now he is interested in fire retardant paints or coatings to reduce the danger of ignition of wooden attics by incendiary bombs.

Flammable Liquids.

Chairman Harold Miner has been so busy with the protection of defense manufacturing projects for the du Pont Company that the revision of the Flammable Liquids Ordinance has been temporarily sidetracked. Besides, the views of the oil industry and of the conservative insurance and fire protection men on this committee as to what constitutes proper regulation in the interest of public safety still seem too far apart for any early agreement.

C. T. Ingalls, Manager of the Oklahoma Inspection Bureau, who once brought this committee to Tulsa for a meeting where they could see the oil

fields and the Seminole Indians enjoying their oil royalties, has now retired from the Bureau and committee service.

David Stroop, Technical Secretary of the American Petroleum Institute, addressed the Boston meeting of the International Association of Fire Chiefs last August on "Fear Prevention."

Forest.

Hugh Fleming, Jr., of the U. S. Forest Service, energetic secretary of this committee, is continually devising new ways to publicize forest fire prevention. His latest is a new forest fire poster, contributed by the Texas Company, and widely distributed by the N.F.P.A., the Boy Scouts and others.

Hazardous Chemicals and Explosives.

Chairman A. H. Nuckolls, Chemical Engineer of Underwriters' Laboratories, has become a spare time farmer, and finds that crops do not always develop in accordance with chemical theory, despite chemical analysis of the soil and scientific fertilizers.

Arthur B. Guise, magnesium fire and incendiary bomb expert of the Factory Mutuals, has this month accepted a position as chief engineer of the Waterfog Division of the Rockwood Sprinkler Company.

Municipal Fire Apparatus.

Current opinion, both in the United States and in England, is veering toward the conclusions in the 1941 report of this committee, presented by Chairman J. N. Sullivan, Commissioner of Public Safety and Fire Chief of Utica, N. Y., to the effect that the trailer pump is not the only prescription for defense fire protection.

Committee member Samuel Pope, Chief of the Boston Fire Department, has been elected Vice-President of the International Association of Fire Chiefs.

Museums, Art Objects and Historic Buildings.

Chairman S. D. McComb, past president N.F.P.A., has recovered from his serious operation last spring and can enjoy lunch at the Drug and Chemical Club, but is still on a somewhat restricted schedule. The active direction of this committee is in the hands of the Secretary, A. C. Hudson of the New Hampshire Board of Fire Underwriters, who, incidentally, is directing the official fire defense organization for his state.

Protection of Records.

A. J. Steiner, of the Protection Department of Underwriters' Laboratories, has been appointed chairman of this committee, upon the acceptance of the resignation of the former chairman, M. L. Carr, Director of the Pittsburgh Testing Laboratories, who asked to be relieved of the chairmanship after five years of service, but who remains a member of the committee.

Safety to Life.

The chairman of this committee, Francis R. Scherer of the Rochester, N. Y., School Department, is now Lieut.-Col. Scherer, stationed in the War Department office in Washington. His army service is not expected to interfere with the current work of the committee.

Ross Davis, former chief of the Philadelphia Fire Department, representative of the International Association of Fire Chiefs on this committee, is now with the Navy in Washington, responsible for the fire protection of shore establishments.

A Mysterious Fire in Shanghai.

A fatal fire which occurred recently in Shanghai has been brought to the attention of the N.F.P.A. Department of Fire Record by Mr. William Charters (Member N.F.P.A.), Chief Officer of the Shanghai Fire Brigade.

One afternoon a call was turned in to Fire Brigade headquarters for apparatus and an ambulance to report to a fire in a trackless trolley, and after dispatching the apparatus and ambulance, an inspector was sent to the scene.

Upon his arrival the inspector found that the fire had been of very short duration and that the apparatus had only to deal with a bit of smoldering woodwork with fire extinguishers. However, 24 persons were suffering from severe burns.

An examination of the inside of the trolley showed that a fire of considerable intensity had raged through the compartment, but that it had been for a very short duration. There was very little charring of the floor, but the seats showed signs of surface burning. The paint on the ceiling had almost completely decomposed into a fine ash, and the handrails were charred.

The windows on the off-side of the car, although damaged, were not badly smoked, and slight traces of varnish deposit showed on these windows when examined. Windows on the near-side were coated with a black deposit of a sooty nature. All windows were open at the time of the fire. But what was even more astonishing were the lamp globes throughout the compartment. All had softened and melted away as a result of the intense heat of the fire.

The inspector immediately discounted all possibility of an electrical or mechanical cause for the fire. In view of the facts (*a*) that the lamp bulbs in the compartment had become sufficiently pliable to fold over without breaking, (*b*) that nine of the 24 persons burned, subsequently died, and (*c*) that the fire had been so swift that it had not taken hold of the woodwork, the inspector ruled that there must have been in the trolley some substance which would be capable of giving off a flammable gas at a high rate of speed.

At the same time it appeared that there had been no definite explosion, no shattering or distorting effect. Furthermore, there were no visible remains of the material which had caused the combustion either in the form of liquid, ash or residue. Neither could there be found any trace or the remains of any container. None of the injured could make a statement regarding a container.

Chemical analysis of scrapings taken from the inside of the vehicle and of clothing worn by persons injured failed to supply any clue, and microscopic analysis was also of no avail.

The inspector's work ended here for there seemed to be nothing else he could do. In view of the fact, however, that nine persons had lost their lives and that 15 others had been severely burned, the case was not forgotten by the Shanghai police. Thus, a month after the fire had occurred, the police found their man.

This man confessed that he had boarded the trolley with a sack, approximately 20 pounds in weight, full of celluloid buttons. Suddenly, as he rode along, he felt heat on his legs, and looking down, he saw that a small hole had been burnt on the bottom of his sack and through this some of the buttons had spilled out onto the floor.

At once he pressed the sack to the floor with the intention of smothering the material, but just then a tongue of flame shot out, burning his hair and eyebrows. This man evidently knew the highly flammable nature of the buttons which he was carrying, for immediately he jumped through a near-by window and landed safely on the roadway. A few seconds later the inside of the trolley was an inferno.

Fortunately there have been no recent cases of fires of this nature in the United States, and although the transportation of nitrocellulose materials in passenger conveyances is generally prohibited by law, it is probable that such materials are frequently carried by passengers.

It is very possible that a smoldering cigarette or lighted match was responsible for the flash fire and subsequent death of nine persons on this Shanghai trolley. The fire emphasizes the importance of "no smoking" in public transportation conveyances and of the enforcement of the law that nitrocellulose materials be not carried by persons on public conveyances. Obviously, the first law is much the easier to enforce.

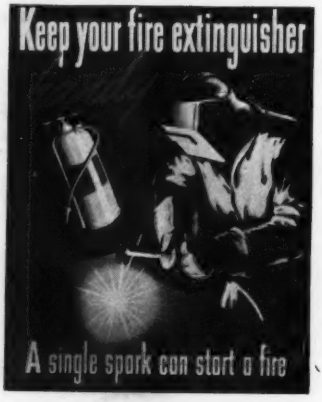
Bethlehem Steel Posters.

Posters, tailor-made to meet the particular fire hazards of the steel industry, are a part of a current fire prevention campaign that is being carried out by the Bethlehem Steel Corporation. Analysis of records that have been kept since 1918 indicates seven major fire hazards. The posters are related to hazards to which the human factor contributes and that lend themselves to pictorial presentation.

They have been printed in two sizes, a 9 in. by 12 in. size for posting on plant bulletin boards and locations with space limitations, and a large size for other locations.

New subjects are posted monthly. Included among poster subjects prepared to date are: Faulty Electrical Wiring, Spilled Oil, Oily Waste, and Welding Sparks. Additional subjects on which posters are being prepared include Hot Metal, Hot Chips, and Borings, and Smoking.

The company has a record, since 1918, of over 45,000 fires occurring on its properties, most of them extinguished before causing any great damage. The seven headings under which they are listed, generally indicative of the common causes of fires on the company's properties, are electrical, hot metal, stoves and stacks, locomotives, acetylene, fuel oil, and ashes. The company's records likewise show that there is a close relation between the rate or extent of operations and fire frequency. The poster campaign has been instituted as one phase of a program for keeping fires at a minimum under existing conditions of expanding operations.



Brooklyn, New York, Waterfront Fire.

By Wm. G. Hayne, Secretary,
N.F.P.A. Committee on Piers and Wharves.

Fire originating in a quantity of sisal, August 18, 1941, spread in a comparatively few minutes throughout Pier No. 27 at the foot of Baltic Street, Brooklyn, New York, and extended to the freighter *Panuco* berthed on the north side of the pier and to barges in the slips on both sides of the pier. Finally the fire spread northward to Pier No. 26 across the 200 ft. slip from Pier No. 27. Thirty-four men were killed by drowning or burning, and a number of men are still reported missing.

The first alarm was received by the fire department fifteen minutes before noon, and eye-witnesses stated that within twenty-five minutes practically the entire superstructure of the pier had collapsed. The *Panuco* and barges were involved almost immediately and Pier No. 26 was soon included in the fire area. Within a short time the superstructure of Pier No. 27 and all the merchandise within it were beyond saving; the 3570-ton freighter *Panuco* had been towed from the pier, beached upon mud flats, and was ablaze from stem to stern; 17 barges, with the merchandise upon them, had been damaged; and the fire department was busily engaged in preventing the fire from spreading throughout the substructure and the roof of Pier No. 26. By afternoon, fires in the piers and barges were practically extinguished, but not until early Wednesday morning was the *Panuco* fire completely extinguished.

This fire demonstrates the conflagration hazard of piers of this type of construction and the exposure hazard they present to adjoining property. The effectiveness of automatic sprinklers is clearly shown by the fact that Pier No. 26 was saved from any great damage by the sprinklers in its superstructure. This fire shows again how fire may travel along the waterfront when slips are crowded by combustible barges and by ships with combustible cargoes. It demonstrates the high degree of quick flammability possessed by merchandise that may be stored upon such piers, and in addition indicates the susceptibilty of such structures to sabotage and air-raid attack.

Construction.

Pier No. 27 of the New York and Cuba Mail Steamship Company was one story in height, of frame construction except for a small portion at the river end. It was 75 ft. in width and 725 ft. in length, covering an area of 54,375 sq. ft. The pier deck was double 3 in. on 4 in. wood planking on wood girders and piles. The roof was composition on wood boards on wood purlins

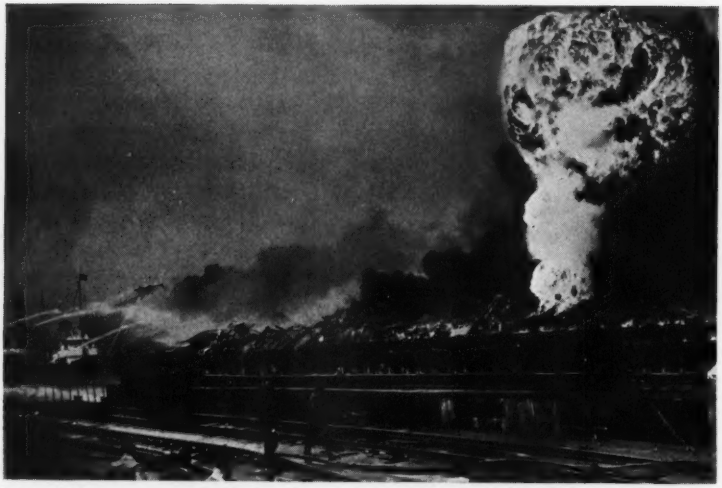
International.

Within a very few minutes Pier 27 was involved from end to end. This picture, taken in the early stages of the fire, shows the pier structure already collapsed. Through the smoke may be seen the "Panuco," which the fireboats have just started to tow away from the burning pier. Concealed by the smoke is Pier 26, which was ignited but saved through the efforts of the fire department. Efforts to rescue men who had been forced to jump into the water were seriously handicapped by the dense smoke.

efforts to rescue men who had been forced to jump into the water were seriously handicapped by the dense smoke.

N. Y. Daily News.

The "Panuco," afire from stem to stern, being towed away from the pier toward the mud flats. The difficulty encountered by land forces in fighting the pier fire from the shore end is evident from this picture.



International.

The fire was made spectacular by explosions of oil drums on the pier.

and trusses. There were no fire divisions and it appears that there was but one draft curtain of wood boards attached to the wood roof at the center of the pier.

Pier No. 26 of the New York Dock Company is one story in height, the superstructure being of the corrugated iron on metal frame type. It is 115 ft. in width and 800 ft. in length, covering an area of 92,000 sq. ft. The pier deck is double 2 in. on 3 in. wood planking on wood girders and piling. Sides are corrugated iron on steel framing with wood corrugated iron covered cargo doors. Roof is composition on wood boards on wood purlins on unprotected steel trusses supported by steel frame side construction. There are no interior fire divisions.

The steamship *Panuco,* operated by the New York and Cuba Mail Steamship Company, is approximately twenty-four years old, and is 351 ft. 7 in. in length, with a tonnage of 3570 tons. The barges were of the usual wooden type of construction, both open and with frame superstructures.

Protection.

Pier No. 27 was provided with a standpipe, with outlets equipped with hose and nozzles. Water pails and chemical extinguishers were distributed throughout the pier.

Pier No. 26 is equipped with a good dry-pipe sprinkler system, installed during 1918 and possessing a grading of 90 per cent. A standpipe system is provided, and there are also monitor nozzles on the roof. Both piers are within the area protected by the city's high pressure system.

Weather Data.

Records of the United States Weather Bureau at the Battery in Manhattan, a short distance from the fire, show that for the first two hours of the fire the temperature averaged 73° F., the humidity 37 per cent. The wind between the hours of 11:00 and 12:00 A.M. was southwest, with a velocity of 14 M.P.H., and from 12:00 to 1:00 P.M. it was south, with a velocity of 13 M.P.H.

Occupancy.

The merchandise upon Pier No. 27 was of a general character, well arranged, with plenty of aisle space. Besides the sisal in various forms there was such material as raw coffee beans, water meters, cast iron soil pipe, paper in cases, portable forges, electrical equipment, metal pipe, paint in cans, oil in drums, metal cabinets, miscellaneous hardware, plumbing supplies, crucibles, and machinery. The cargo of the *Panuco* was as follows:

238 barrels white arsenic
19,669 bars refined lead
100 bales high density cotton
1400 bales cotton
94 empty ammonia cylinders
2664 cases crude rubber
20 bales sarsaparilla root
101 bags Mexican beeswax
3 cases soap essence
12 bales bristles
150 flasks quicksilver
153 bales South Tamaulipas sisal
20 bales untanned goatskins
1524 bags Candelilla wax
945 bales ixtle
1045 reels unoiled sisal twine
3 bales salted shark hides
2 bales shark fins
460 coils henequen rope
11 bales henequen rope
62 bales henequen yarn
2250 bales henequen clean
100 bales henequen steined
167 bales sisal twine
20 coils sisal twine
356 bales unoiled sisal twine
524 coils unoiled sisal twine
76 bales dyed sisal twine
195 bales sisal waste
50 bales said to contain 5000 empty sisal bags
50 bales said to contain 10,000 empty sisal bags

The barges that were not being used for the *Panuco's* cargo contained such material as paper in rolls, cable, steel, pipe, machinery, insulating material, and similar items.

It is reported that a portion of the merchandise upon the pier and barges was intended for U. S. Naval bases.

Story of the Fire.

After discharging a portion of its cargo, consisting of copper bars, at Perth Amboy, New Jersey, the steamship *Panuco* proceeded to Brooklyn and docked on the north side of Pier No. 27, Sunday, August 17. The following morning at 8:00 A.M. it began unloading the remainder of its cargo upon Pier No. 27 and upon lighters alongside. During the morning, the cargo placed upon the pier was principally henequen, ixtle, and sisal twine in bales, while cotton was unloaded on at least one lighter. The sisal fiber was stacked along both sides of the pier in a number of piles, separated by other merchandise that

was awaiting shipment. The largest pile of the fiber appears to have been about 100 ft. from the shore end of the pier, being about 50 ft. long, 20 ft. wide, and probably 15 ft. high. Other piles of the fiber were considerably smaller.

At approximately a quarter to twelve the first alarm was received from box No. 507, located at Columbia and Baltic Streets, Brooklyn. Alarms from numerous other street boxes and special building signals were received almost at the same time. Fire that appears to have originated in the pile of fiber toward the shore end of the pier spread within a few moments' time throughout the pier and to the superstructure and hold of the steamship *Panuco*. It then spread to the lighters and their contents, and to Pier No. 26. The spread of the fire was so rapid that many of the several score of men at work upon the pier and the *Panuco* were forced to leap into the water. A considerable number of these men either could not swim or were exhausted before help arrived, and they drowned. It is reported that because of the dense smoke rescuers were unable to see the men in the water. Other men were unable to leave the *Panuco* before they were burned to death. A total of 34 bodies have been recovered so far, with a number of men still reported missing.

Upon the arrival of the fire department the fire had already reached the proportions of a five-alarm fire, and consequently in rapid succession a second alarm was sounded at 11:50 A.M., a third at 11:51 A.M., a fourth at 11:52 A.M., and a fifth at 11:53 A.M., bringing a large portion of the land and marine forces of the fire department to the pier. Tugboats succeeded in securing a line to the *Panuco*, which was then towed out into the channel and finally beached on mud flats in the lower bay, ablaze from stem to stern. The fire department then concentrated upon preventing the spread of the fire to Pier No. 26, where it had already ignited the roof covering, cornice and substructure. This pier was unoccupied, and consequently the fire department's efforts were concerned entirely with the pier itself. The department was aided by the operation of fourteen sprinkler heads upon the pier, but some difficulty was experienced in extinguishing the fire in the cornice and in the substructure, which were without protection. The substructure fire was finally extinguished by a fireboat working in the 200 ft. slip, with the help of tugs and other small craft which could get up closer to the pier. The department was also forced to give considerable attention to the burning barges and their contents. Tugboats and other craft gave valuable assistance in extinguishing the fire in Pier No. 27 and on the barges. Fires in the piers and barges were quickly brought under control and practically extinguished by the afternoon.

The fire in the *Panuco* was decidedly stubborn, and it was not until early Wednesday morning that a fireboat crew was able to explore the ship's interior. Exploding oil drums on the pier caused the fire to burn spectacularly.

International.

By midafternoon the fire in Pier 27 was practically burned out. In the background may be seen a number of the tugs which assisted the fireboats.

Two automobiles parked in front of the entrance to Pier No. 27 are evidence of the intensity of the fire, for their windshields and windows melted and were draped about the cars.

Origin.

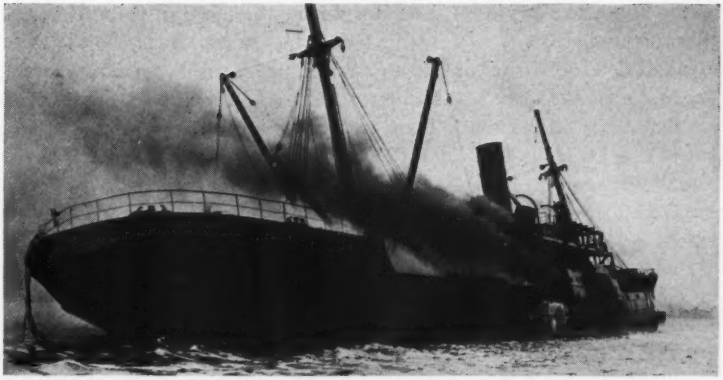
The cause of this fire has not been determined. In the absence of evidence to the contrary, it is being accepted as having been due to some ordinary cause. However, it would have been exceedingly easy to start this fire without leaving any evidence of incendiarism.

Damage.

The entire superstructure of Pier No. 27 was destroyed, and the deck and piling were considerably charred. Merchandise upon the pier was also severely damaged. The extent of the damage to the steamship *Panuco* and its cargo is not definitely known at present. It is certain, however, that that part of its cargo susceptible to fire and water damage must be seriously affected. The ship itself is a badly burned hulk resting upon the Gowanus flats. A portion of the side, roof and substructure of Pier No. 26 were damaged, and practically all of the skylights were broken. Many of the seventeen barges and their cargoes in the slips were burned. Some water damage was also caused at 2-42 Warren Street, when a below-ground pipe of the sprinkler system ruptured under the first floor of the building, apparently because of the 200 pounds pressure applied by the fire department to the Pier No. 26 siamese connection, which is interconnected with this system. In addition, at 2-50 Congress Street, one sprinkler head was caused to leak on the first floor and one at the bulkhead at the front part of the roof, although apparently there was no damage. The two automobiles parked in front of Pier No. 27 appear to be completely destroyed. Between $1,500,000 and $2,000,000 is the present estimate of the total monetary loss.

Conclusions.

This fire should make all the more apparent the extreme vulnerability to quick destruction by fire of piers constructed as was Pier No. 27. It is unfortunate that the rapid spread of this fire and destruction of the pier are generally being accepted as something exceptional, when existing evidence in the form of numerous pier fires clearly proves the contrary. For instance, on August 20, 1917, twenty-four years ago almost to the day, a fire occurred in Pier No. 26, the next pier north of No. 27 and also involved in the present fire. Pier No. 26 at that time was practically identical in construction to the present day Pier No. 27, although not quite so large. At the time of that fire the pier contained hides, fertilizer, burlap and general merchandise which could hardly be classified as highly flammable. The watchman, in his testimony to the fire marshal, stated: "The blaze started in a heap of empty grain bags . . . the fire spread so quickly I didn't have a chance to get my coat." That fire spread throughout that pier, to two steamships, five lighters, and three tugboats. Four alarms were sounded in just as rapid a succession as those sounded for Pier No. 27, and the fire was not extinguished until the superstructure of the pier was consumed and the pier deck, girders and piling were considerably charred. The merchandise on the pier was badly damaged, as were the two steamships and smaller craft. Fortunately, that fire occurred in the early morning when there were no workmen upon the pier and there was no loss of life. The report of that fire concluded: "Buildings of frame construction and of large unbroken floor areas such as this and many other wood-enclosed piers are serious conflagration breeders



International.

The "Panuco" smouldered for days where grounded on the flats off Brooklyn. It was two days after the fire before the vessel could be boarded to search for bodies of victims in the hold.

and should be protected by automatic sprinklers." Pier No. 26 was reconstructed and was equipped with automatic sprinklers that operated effectively in this present fire. The lesson, so expensively learned by that fire, was never applied to Pier No. 27, for its construction was not altered nor was it sprinklered. The records are full of serious pier fires that have occurred before and since 1917, of which the Jersey City waterfront fire is a more recent example.* The necessity of improving existing piers so as to reduce their susceptibility to these disastrous fires, particularly in view of the extensive loss of life at this fire, is now so evident that it would seem that these matters must have immediate attention from the city authorities who are charged with the responsibility of the proper construction and protection of waterfront property. Complete information for the proper construction and protection of piers and wharves against fire has been in existence for years and is readily available.†

The Port of New York does not stand alone in this laxity to adopt and enforce proper legislation governing the protection of piers and wharves, for a recent survey made by the Committee on Piers and Wharves of the N.F.P.A. has shown this to be quite universal throughout all of the major ports of the United States. In view of the national crisis, it appears that no further time should be lost in improving pier and wharf conditions. It seems absurd to permit material so urgently needed for national defense, and which has consumed much capital and many needed man-hours of work, to rest upon pier

*See QUARTERLY, July, 1941, p. 83, for New York Board of Fire Underwriters' Report on Jersey City Waterfront Fire, May 31, 1941.

†N.F.P.A. Recommended Good Practice Requirements for the Construction and Protection of Piers and Wharves.

structures such as Pier No. 27 and many others where it is so seriously exposed to destruction by fire.

The existence of sisal on this pier undoubtedly was a contributing factor in the lightning-like spread of this fire. Sisal or sisal hemp is the fiber obtained from the leaves of the agave plant, native of Central America. There are several varieties of the fiber known by their Mexican names, such as henequen and ixtle. In the January, 1921, QUARTERLY is an extensive report on sisal, compiled by Underwriters' Laboratories. In the conclusion this report in part reads:

> *Ignition by Sparks and Flame.* The product is easily ignited by contact with ordinary sparks such as are discharged by coal burning locomotives or lighted cigarettes. Ignition readily occurs by contact with a small flame such as produced by an ignited match.
>
> *Combustion.* When ignited by contact with flame, sisal burns rapidly, the flame spreading very fast and producing a hot fire. Local flash fires occur on ignition by a flame, but the area covered by the flash period is not large. The flash is produced by projecting ends of fibers, the number of which at any given place on the bale varies. Ignition from contact with live sparks may result in the immediate production of flame or a smoldering fire which is likely to burst into flame sooner or later according to conditions. A smoldering fire may burrow to a considerable extent.
>
> *Spontaneous Ignition of Sisal.* Baled sisal is not liable to spontaneous ignition under ordinary storage conditions.

It is evident that sisal is a product with marked fire hazard qualities and should be treated accordingly.

The exact cause of this fire is not known, and that in itself is of importance. It is important because it cannot be definitely determined whether or not it was due to normal causes or to sabotage. It is important because if it was not due to normal causes, then it indicates the ease with which a fire that will reach the proportions of this one may be started by a saboteur. If a match or lighted cigarette were all the tools that were needed to produce this fire, then the problem of protecting such piers against sabotage is a major one.

The automatic sprinkler system in Pier No. 26 functioned as intended, and if there had been merchandise upon this pier the existence of this system would have been of immeasurable value. The sprinklers, however, are installed in and protect only the superstructure, the wooden substructure being entirely unprotected. When the substructure became ignited therefore, it was only because of the splendid work of the fire department that the fire did not spread throughout the substrucure. Protection of a flammable substructure is as important as protection of the superstructure. This has been clearly demonstrated by numerous substructure pier fires, of which the Cunard Pier No. 54 North River fire of May 6, 1932, is but one example.*

*See QUARTERLY, July, 1932, p. 48, for New York Board of Fire Underwriters Report on Pier No. 54, North River, May 6, 1932.

Burning Tests of Common Plastics.

By A. J. Perkins, Ph.D.*

Plastics find their way into almost every phase of life today; such diverse products as automobile dashboards, cups, scales, gears, electrical insulators, and furniture being manufactured from them. Until recently, the plastics industry has been producing mainly cellulose acetate, cellulose nitrate, and phenol-formaldehyde resin plastics. However, within the last few years, this field has expanded rapidly due to the introduction of many new materials which, in general, are synthetic resins. Among the newer resins used in manufacture of plastics are the acrylate resins, the polystyrene resins, the urea-formaldehyde resins, and the vinyl resins.

Underwriters' Laboratories, Inc., has made a preliminary investigation to determine whether some of the more commonly used plastics are combustible or non-combustible.

There are about twenty-two types of plastics available today, each type embracing numerous individual compositions. Since it was obviously impracticable to test all of the thousands of available compositions, representative samples of each of twelve of the more important commercially produced plastics were obtained. They included the following: cellulose acetate, cellulose acetate butyrate, acrylate, polystyrene, poly-vinyl alcohol, poly-vinyl chloride, vinyl-chloride vinyl-acetate copolymers, phenol-formaldehyde, urea-formaldehyde, casein, coumarone-indene, and cold molded plastics. Cellulose nitrate was omitted since its fire hazard is well known. Cellulose acetate, which is classified as slow-burning, was included for comparison.

Burning tests were conducted on sections of the samples to determine whether or not they were combustible. These tests were designed to give, in addition, information as to the relative ease of ignition, and a rough indication of the comparative burning rate of the various specimens; the relative ease of ignition being measured by the duration of application of a standardized test flame to the specimen necessary to cause ignition; and the comparative burning rate being indicated by the length of time the specimens burned. From these data a general classification of the combustibility may be made, since it is mainly dependent upon these two factors, the ease of ignition and the comparative burning rate. The quantitative classification of the plastics tested with regard to combustibility, which would entail the determination of the

*Assistant Physical Chemist, Underwriters' Laboratories, Inc. (Member N.F.P.A.). The article has been abstracted from Underwriters' Laboratories, Inc., Bulletin of Research No. 22, "Comparative Burning Tests of Common Plastics."

ignition temperature, and an exact comparison of the burning rates, as well as tests using larger samples, was beyond the scope of this investigation.*

Eleven of the plastics tested were obtained in the form of slabs or sheets of various thicknesses as shown in the table. Some of the physical characteristics of these plastics are given in the table. The cellulose acetate samples represented the range of compositions produced by two different manufacturers. As representative of the range of phenolic molding materials, three samples were obtained having cotton filler, wood filler and asbestos filler respectively. Also, a sample of cast phenolic plastic was obtained. The six vinyl-chloride vinyl-acetate copolymers tested represented the range in both plasticized and unplasticized plastics of this type.

Methods of Test.

Where the size of the samples permitted, specimens in the form of bars, ¼ by ¼ by 6 in. were prepared for the burning tests. In the case of the samples having a thickness less than ¼ in., two specimens were prepared, one having a width of ¼ in., and the other having a width such that the cross sectional area of the specimen was $\frac{1}{16}$ sq. in. This was done so that burning times of equal volumes could be obtained.

The test flame used as a source of ignition was a ¾-in. high luminous (yellow) gas flame.†

The test specimens were hung vertically in an enclosure designed to prevent drafts, and the test flame was applied to the lower end of the specimen. The duration of application of the test flame, the length of time that the specimen burned, and the height of flame were recorded in each case. Any afterglow was also noted.

Discussion of Results.

On the basis of the test results, it appears that the plastics tested fall into three groups (designated in the fourth column of the table as 1, 2 and 3) with regard to their relative combustibility. Group No. 1 includes those plastics which are ignited by the test flame in approximately the same time, and burn at about the same rate as cellulose acetate. Group No. 2 includes those plastics burning with a feeble flame which is extinguished by a slight draft and which may or may not propagate away from the point of ignition. Group No. 3 includes those plastics which burn only during the application of the test flame.

*The investigation did not cover the hazards of the original manufacture of the various plastics. The manufacture of some plastics involves the use of flammable liquids and certain hazardous materials and processes, but these hazards do not extend to the finished product or its use in ordinary manufacturing operations except where some flammable liquid is used to dissolve the plastic.—Ed.

†Dimensions of test flame approximately the same as those of the flame of a common strike-on-the-box match.

Equipment and method employed in burning tests of plastics. (Note burning residue on floor.)

Cellulose nitrate, among whose hazardous properties is that of exothermic decomposition, would fall into a group more hazardous than those outlined above.

GROUP NO. 1. Cellulose acetate was taken as a standard of comparison for the plastics included in Group No. 1. Seven of the eight individual compositions of cellulose acetate tested ignited within 10 sec. after the application of the test flame and burned completely in from 3 to 5 min. One specimen required a 15 sec. application of the test flame, but when ignited, burned at about the same rate as the other cellulose acetate compositions. Of the other plastics tested, the following had approximately the same ignition and burning times as the cellulose acetate plastics and are thus included in Group No. 1: The cellulose acetate butyrate plastics; the acrylate plastics; the polystyrene plastics, and one sample of polyvinyl alcohol plastic.

GROUP NO. 2. The casein plastics were ignited rather easily, but burned for only a short time before being extinguished, the flame not being propagated to the unburned portion. The cast phenolic and the cotton-filled molded phenolic plastics were somewhat more difficult to ignite than the casein plastic, but once ignited propagated flame their entire length. The wood-filled molded phenolic plastic burned for only a short time after ignition, flame not being propagated to the unburned portion. One sample of urea formaldehyde plastic, although difficult to ignite, propagated flame its entire length, whereas the other sample burned for a short time at

the point of ignition and then went out. One specimen of plasticized vinyl-chloride vinyl-acetate copolymer ignited rather easily and burned with a feeble flame, which was easily extinguished by a slight draft. Thus, although combustible, the particular compositions discussed above appear to be much less so than those in Group 1.

GROUP No. 3. In this group are placed those plastics which did not propagate flame after the removal of the test flame. It includes the cold molded

Specimens of Plastic Subjected to Burning Tests.

Plastic	Sample	Trade Name	Combustibility Group	Thickness, In.	Color	Fabrication	Nature	Remarks
Cellulose Acetate	A	Tenite I	1	1/16	Red	Molded	Thermoplastic	
	B	Tenite I	1	1/4	Gray	Molded	Thermoplastic	
	C	Tenite I	1	1/4	Blue	Molded	Thermoplastic	
	D	Tenite I	1	1/4	Amber	Molded	Thermoplastic	
	E	Fibestos	1	1/4	Crystal	Molded	Thermoplastic	
	F	Fibestos	1	1/4	Crystal	Molded	Thermoplastic	
	G	Fibestos	1	1/4	White	Molded	Thermoplastic	
	H	Fibestos	1	1/4	Red	Molded	Thermoplastic	
Cellulose Acetate Butyrate	A	Tenite II	1	1/16	Clear	Molded	Thermoplastic	
	B	Tenite II	1	1/4	Clear	Molded	Thermoplastic	
Acrylate	A	Lucite	1	1/8	Clear	Molded	Thermoplastic	
	B	Plexiglas	1	1/4	Clear	Cast	Thermoplastic	
Polystyrene		Bakelite Polystyrene	1 1	1/16	Clear	Molded	Thermoplastic	
Polyvinyl Alcohol	A	Resistoflex	1	1/16	Amber		Thermoplastic	
	B	Resistoflex	3	1/16	Amber		Thermoplastic	
Phenol-formaldehyde	A	Opalon	2	1/4	Yellow	Cast	Thermosetting	
	B	Resinox	2	1/4	Black	Molded	Thermosetting	Cotton-filled
	C	Resinox	2	1/4	Black	Molded	Thermosetting	Wood-filled
	D	Resinox	3	1/4	Black	Molded	Thermosetting	Asbestos-filled
Urea-formaldehyde	A	Plaskon	2	1/16	White	Molded	Thermosetting	
	B	Beetle	2	1/4	Cream	Molded	Thermosetting	
Casein	A	Ameroid	2	1/4	Pink	Molded	Thermoplastic	
	B	Ameroid	2	1/4	Black	Molded	Thermoplastic	
Vinyl-Chloride Vinyl-Acetate Copolymers	A	Vinylite	2	1/8	Clear	Molded	Thermoplastic	Plasticized
	B	Vinylite	3	1/8	Clear	Molded	Thermoplastic	
	C	Vinylite	3	1/8	Clear	Molded	Thermoplastic	
	D	Vinylite	3	1/8	Black	Molded	Thermoplastic	Unplasticized
	E	Vinylite	3	1/8	White	Molded	Thermoplastic	
	F	Vinylite	3	1/8	Clear	Molded	Thermoplastic	
Polyvinyl Chloride		Koroseal	3	1/4	Black	Milled	Thermoplastic	Plasticized
Cold Molded		Thermoplax	3	1/2	Black	Molded	Thermosetting	

plastic, the plasticized poly-vinyl chloride plastic, two samples of the plasticized vinyl-chloride vinyl-acetate copolymers, three samples of unplasticized vinyl-chloride vinyl-acetate copolymers, the asbestos-filled molded phenol-formaldehyde plastic and one sample of plasticized poly-vinyl alcohol.

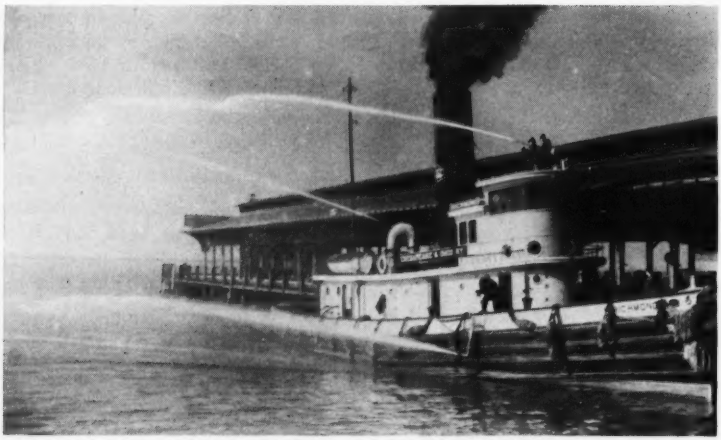
The coumarone-indene plastic has not been placed in any one of the three groups because it was not possible to make even a rough comparison of its burning rate with that of the other plastics tested, due to its different physical form.

It must be borne in mind that the relative combustibility of any particular plastic composition depends not only on the synthetic resin used but also on the plasticizers, fillers, and pigments incorporated in it. As shown by the difference in behavior of the two poly-vinyl alcohol samples, the plasticizer used with the synthetic resin in the manufacture of the plastic may have a profound effect on the relative combustibility of the finished product. The effect of the type of filler used is well illustrated by the results obtained on the three samples of molded phenolic plastic, containing cotton, wood, and asbestos fillers respectively. Because of these facts, an individual composition of a particular type of plastic may fall into a different group from the samples of the same type of plastic used in these tests.

C. & O. Railway Tug Fireboats.

W. A. Radspinner (Member N.F.P.A.) has contributed the accompanying photograph showing the Chesapeake and Ohio Railway tug, *Richmond,* which is one of three similar tugs plying between Norfolk and Newport News. It is common practice for tugs to be equipped with monitor nozzles on top of the pilot house, and such nozzles are frequently of service in waterfront fires. The usual tug monitor nozzle, however, is supplied by a pump of only about 500 gallons per minute or smaller capacity, and its effectiveness is somewhat limited. Mr. W. A. Radspinner, Superintendent of Fire Protection, and Mr. W. T. Newell, Superintendent of Floating Equipment, are responsible for the design of these C. & O. tugs, which are equipped with 2000-gallon per minute fire pumps and are capable of developing 150 pounds pressure.

The unique feature shown in this picture is the special nozzle near the water line, designed for fighting fires under pier decks that would otherwise be inaccessible. The nozzle shown directs a powerful stream which can reach all the underdeck space to the center of the railroad piers. It can be directed by a man on the deck, and is equipped with sufficient length of hose so that it can be moved at any point on the side of the tug. This protection was devised primarily for the C. & O. piers at Newport News, which, while provided with complete automatic sprinkler protection above the pier deck, are not sprin-



The C. & O. Railway Tug "Richmond."

klered in the underdeck space. These special nozzles supplement other protection for the space under the pier deck which can be reached from openings at the side of a depressed track area. There is a strong water supply for the local fire protection system, the city fire department is quickly available, and the railroad switch engines are equipped with fire pumps and hose. With the superstructure sprinklered and the facilities for attacking fires in the underdeck space both from the center of the pier and from the side through these special nozzles, Mr. Radspinner considers the piers well protected.

The picture shows solid streams, but in the case of an oil fire or other type of fire where a spray nozzle would be preferable, the tips can be readily replaced by spray tips. These boats are frequently called in at fires in the Hampton Roads area and have given a good account of themselves in several important fires.

Chemical Extinguishers for Incendiary Bombs.

By Arthur B. Guise (Member N.F.P.A.),
Chemical Engineer, Factory Mutual Laboratories.

Extinguishers of the usual types do not extinguish burning magnesium, and may even be dangerous to use on magnesium fires because of explosive reactions.* However, certain existing types of fire extinguishers can be used effectively to cope with light magnesium incendiary bombs. Exhaustive tests made under a variety of conditions on actual bombs have demonstrated that water-filled and soda-acid types of extinguishers, common in most industrial plants, large mercantile establishments, institutions and public buildings can be used to great advantage to control incendiary bomb fires.

Some of our conclusions disagree with previously published information. One reason for this is that much of the instruction now being given as to how to handle incendiary bombs still is based on a handbook issued by the British government in 1938, before the war started. This handbook served its purpose excellently in preparing the British people for intensive bomb raids which they suffered during the last half of 1940. But certain statements regarding incendiary bombs and certain techniques for handling them have been modified by later information and experience.

To produce the coarse spray that is effective on burning magnesium bombs, the operator places his thumb over the orifice of the nozzle of a soda-acid fire extinguisher. Removal of the thumb instantly gives the operator the normal solid stream to direct upon fire in ordinary combustibles that may be started by the bomb.

*See "Magnesium and Its Alloys," April, 1941, QUARTERLY, page 374.

Repeated tests show that the very fine spray produced by samples of the English type stirrup pump observed and tested by the Factory Mutual Laboratories is not necesarily the best spray for magnesium bomb fires. We found out, too, that British "snuffers" can not really snuff out an incendiary bomb. Theoretically, water is the wrong thing to use on burning magnesium; but as a practical matter it often is the best. None of the usual fire extinguishers can extinguish burning magnesium, but, where there are enough extinguishers of the water-filled and soda-acid types available, they can be used successfully to control incendiary bomb fires.

A solid stream of water from any source when applied directly to a burning magnesium bomb causes an explosive reaction, sending particles of metal for distances of from 10 to 20 feet. But a spray may safely be directed upon the bomb, greatly reducing the time of its burning and wetting down the area around the bomb to restrict the spread of fire. This spray can be produced from water-filled or soda-acid fire extinguishers by inserting the ball of the thumb into the stream. The adjustable nozzle of a garden hose or the English type stirrup pump also will produce a spray. There is considerable difference in the practical effectiveness of various sprays. The reason that the spray from the British stirrup pump is not the best is principally its limited volume and range. A more effective spray is one considerably coarser, because the coarse spray has better range and penetration through fire drafts and a greater wetting effect on surrounding combustibles. A suitably coarse spray is that produced from any water-filled or soda-acid fire extinguishers by "thumbing" the jet.

Partition Fire Tests.

By S. H. Ingberg and Nolan D. Mitchell.

A series of 147 fire tests of wood- and metal-framed partitions has been recently completed at the National Bureau of Standards. Seventy-eight of the partitions were of wood or framed with wood studs. They were faced with wood, plywood, wood-fiber boards or gypsum boards, or with plaster on lath of various types. The others were of solid or hollow incombustible, non-bearing types, most of which were framed with steel channels and had body or facings of gypsum or portland cement plaster on metal lath. All but four of the wood stud partitions were of load-bearing types and 38 of them were under load while exposed to the test fire. Those partitions not subjected to load were tested restrained within the frames into which they were built.

Materials and Workmanship.

The materials were of the quality generally used in building construction and most of them were obtained in the local market. The 2 by 4 in. wood studs were of yellow pine or Douglas fir, largely of No. 1 common grade. Most of the steel frames for partitions were made of either cold-rolled strip-steel or hot-rolled channels, usually of ¾ in. depth. A few were of special channels of proprietary design.

The weight of wire lath was 2.1 lbs. per sq. yd., and that of expanded metal ranged from 2.2 to 3.5 lbs. per sq. yd., including three types of paper-backed laths. Gypsum laths and plasterboard were ⅜ in. thick and were either plain, perforated or indented. Most of the wood lath was of spruce, but some was of pine and cypress. Fiberboard was used as the plaster base for five partitions.

Potomac River sand, consisting largely of quartz, was used in all sanded plaster facings except three made with Fox River (Illinois) calcareous sand.

The quality of workmanship was within the range of that obtaining in local building practice. Most of the partitions were constructed under contracts awarded to the lowest bidders.

Construction.

Wood-stud frames were assembled by toe nailing the studs to 2 by 4 in. top and bottom plates at 16 in. intervals, and those of steel by wiring the stud ends to channel runners at top and bottom either directly or by means of

A more detailed report of these tests is given in National Bureau of Standards publication BMS71, "Fire Tests of Wood- and Metal-Framed Partitions," which can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 20 cents per copy.

clips. Channels or 2 by 4 in. scantlings were wired to the ¾ in. or 1 in. steel-channel studs of metal-framed partitions to hold them temporarily in alinement until the first coats of plaster had set. The solid partitions of portland cement mortar sprayed on against a board backing had no studs but were reinforced with 4 by 4 in. mesh of No. 6 gauge wire fabric.

Fiberboards, plasterboards, and lath ⅜ to ½ in. thick were nailed to wood studs with 3 or 4d nails spaced 4 to 8 in. apart, ⅞ in. fiberboards with 5d nails, similarly spaced, and metal lath with 6d nails, spaced not over 7 in. on centers, driven 1 in. and bent over. Metal lath was attached to channel studs by wiring at 6 or 7 in. intervals, and overlapped edges were wired together between studs. Asbestos or wood fiberboards used as plaster bases for solid partitions were held in the channeled edges of H-shaped sheet-metal studs.

Plasters were proportioned by weight of dry materials. Equivalent volume proportion can be obtained by assuming gypsum and Keene's cement to weigh 67 lbs. per cubic ft., hydrated lime 40 lbs. per cubic ft., portland cement 94 lbs. per cubic ft., sand 100 lbs. per cubic ft., and sawdust 12 lbs. per cubic ft.

A one or two day interval was allowed between the application of scratch and brown coats of plaster on metal lath, but on rigid bases the second coat was applied before set of the first had begun. Keene's cement was added to the lime plaster for several partitions to improve the strength of the plaster. A period of not less than four weeks was allowed for curing the plaster before testing. During the last two or three weeks of this period the plasters were cured dry, the drying being accelerated when considered necessary by the use of a unit heater or low heat from the furnace to drive off excess of free water. The thickness of plaster was taken as the average of the thickness of the facing over the rigid lath and as the average from the back of expanded metal and wire lath.

Twelve partitions had mineral-wool fills between the studs, and one prefabricated metal wall was filled with expanded vermiculite.

Equipment and Method of Testing.

Details of the large furnace used for most of the tests are given by Fig. 1. A few supplemental tests were made on 4 ft. square partitions in a smaller gas-fired furnace. The deviations in test procedure from the standard specification for fire tests were in the size of the 8 small panels and the division of 19 of the large partitions into two sections, and two of them into three sections having areas less than the prescribed minima. However, due to the similarity of the sections and the absence of restraint at borders between sections, it is thought that conditions obtained substantially equivalent to those for the undivided panels. It will be noted that most of the constructions tested in 4 by 4 ft. panels were also tested in panels of larger size. Nearly all of the load-

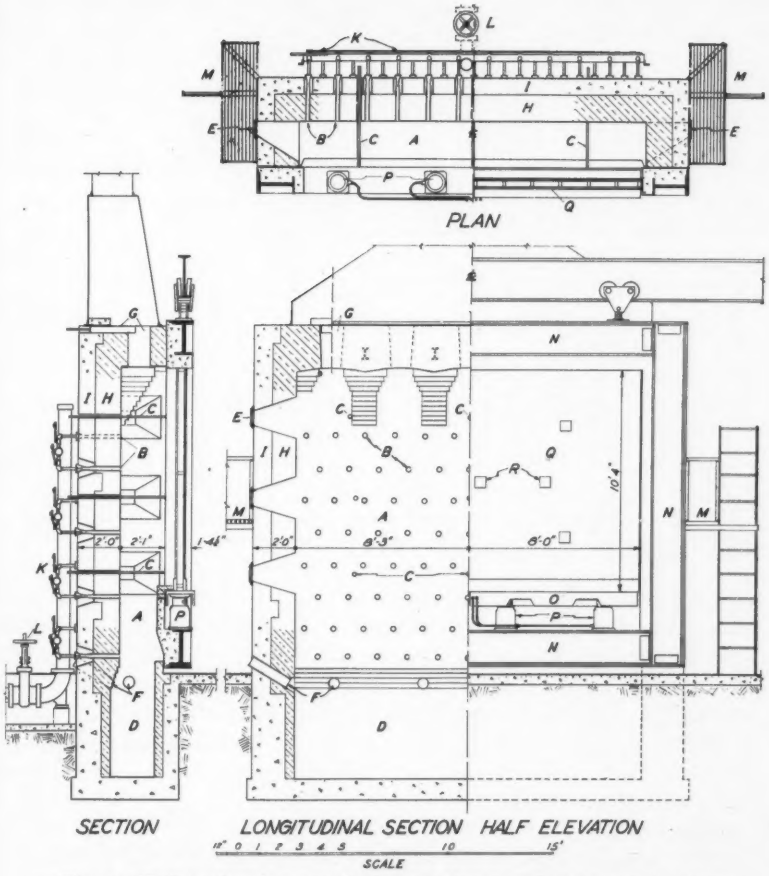


Fig. 1. Wall testing furnace: A, furnace chamber; B, burners; C, thermocouple protection tubes; D, pit for débris; E, mica windows; F, air inlets; G, flue outlets and dampers; H, firebrick furnace lining; I, reinforced concrete furnace shell; K, gas cocks; L, control valve; M, ladders and platforms to upper observation windows; N, movable fireproofed test frame; O, loading beam; P, hydraulic jacks; Q, test wall; R, asbestos pads covering thermocouples on unexposed surface of wall.

bearing partitions subjected to the hose-stream test were tested in the restrained condition without load, instead of being tested under load, as provided by the test specifications, the ability to sustain working load for the full rated period having been proved in previous fire tests.

Each partition with its test frame was placed to form one wall of the com-

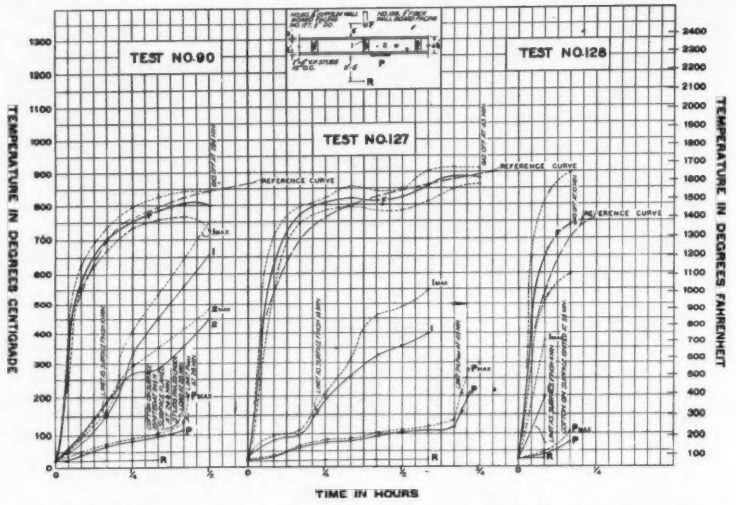


Fig. 2. Temperatures in fire-endurance tests of wood stud partitions faced with ⅜ in. and ½ in. gypsum wallboards, tests Nos. 90 and 127, and ½ in. thick wood fiberboards, test No. 128.

bustion chamber of the furnace. Loads of 30,500 lbs., corresponding to 360 lbs. per sq. in. of net area of wood studs, were applied to those to be tested under load previous to starting the fire and maintained until failure occurred. The criteria of such failure were any of the following: Inability to support the working load; collapse; passage of flame through the partition; or a temperature rise on the side not exposed to fire of 250° F. (139° C.) above the initial taken as the average at three or more locations; or a maximum rise of 325° F. (181° C.) at any one point.

The hose stream test applied to 33 partitions was made by withdrawing the frame containing the partition from the furnace at the end of the prescribed fire-exposure period and impinging a stream over all parts of the hot surface from a 1⅛-in. fire hose nozzle 20 ft. from the partition supplied with water at 30 lbs. per sq. in. pressure. The period of application of the hose stream was 1½ min. per 100 sq. ft. of area of the partition for ratings of less than 2 hr., and 2½ min. per 100 sq. ft. for ratings of 2 to 4 hr. A partition was considered to have failed in the hose-stream test if a hole was broken through by the hose stream.

Results of Tests.

Typical time-temperature diagrams are given in Figs. 2, 3 and 4. Fig. 5 is a view of a partition after test. The fire resistance ratings derived from the tests are given in Tables 1 and 2, each result being based on one to ten fire-

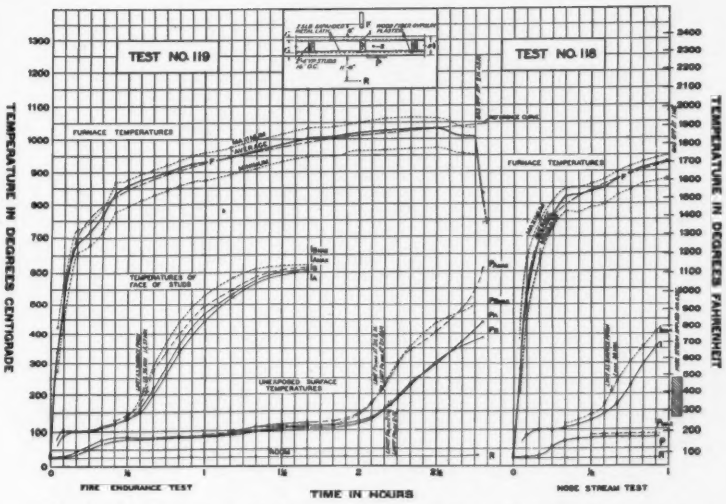


Fig. 3. Temperatures in fire-endurance and fire and hose-stream tests of wood stud partitions faced with 1 in. of neat wood-fibered gypsum plaster on expanded metal lath; tests Nos. 118 and 119.

endurance tests besides hose-stream tests where made or applicable. They are taken 5 min. apart up to 40 min., at 15 min. intervals from ¾ to 2 hr., and at ½ hr. intervals for higher ratings.

The partitions framed on 2 by 4 in. wood studs and faced with wood or wood-fiber boards, and those of solid tongued and grooved wood construction 1½ or 1⅝ in. thick were found to be among the most vulnerable to fire. The use of asbestos paper as membranes in these constructions delayed fire penetration and placed them in the 25 to 45 min. range, which is comparable to results with facings of flameproofed wood-fiber boards or gypsum wallboards (Table 1). A wood-stud partition faced with ½ in. gypsum wallboard on both sides attained a rating of 40 min., and when having a fill of mineral-wool bats nailed into the sides of the studs the rating was increased to 1 hr. A 3 in. thick partition of prefabricated plywood panels filled with mineral wool failed at 52½ min. and attained a fire-resistance rating of ¾ hr., and one of the same thickness of prefabricated steel panels filled with expanded vermiculite reached its limit just under ½ hr., because of temperature rise on the unexposed side, but remained a barrier to fire for a longer period.

Wood-stud partitions faced with ½ in. thickness of gypsum plaster over fiberboards or wood lath, and lime plaster over wood lath qualified for the ½ hr. rating (Table 2A), the lime plaster giving a little lower fire resistance than the gypsum plaster. Filling the stud space with mineral wool bats in-

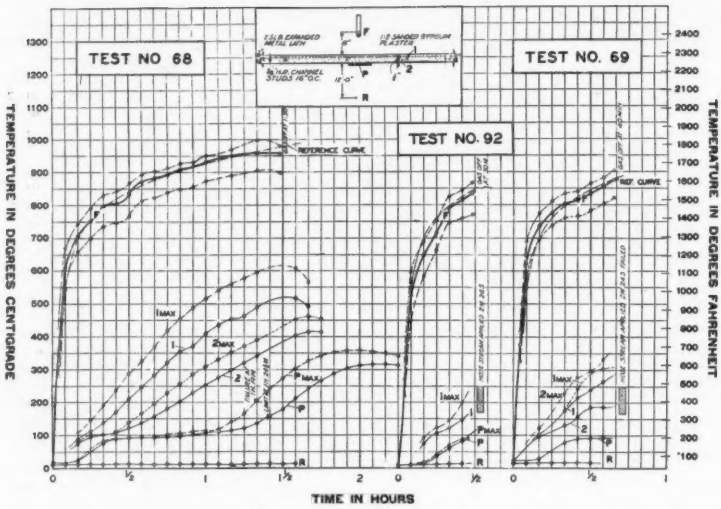


Fig. 4. Temperatures in fire-endurance and fire and hose-stream tests of 2½ in. thick solid non-load-bearing partitions of sanded gypsum plaster on metal studs and metal lath; tests Nos. 68, 69 and 92.

creased the fire resistance of the partitions faced with wood lath and gypsum plaster to 1 hr., and that with lime plaster to 40 min.

With facings of ½ in. thick 1:2 sanded gypsum plaster on perforated gypsum lath, or of ¾ in. thickness on metal lath, a 1 hr. fire-resistance rating was attained (Table 2B). Lime or portland cement plaster facings ¾ in. thick on metal lath gave ½ hr. fire resistance, and the same thickness of lime plaster gauged with Keene's cement gave ¾ hr. The addition of 3 or 6 lbs. of asbestos fiber per bag of cement improved the fire resistance of sanded portland plaster markedly. Such plaster also retained its integrity better under fire exposure and hose-stream application than other kinds tested. The use of neat wood-fibered gypsum plaster applied on metal lath extended the fire resistance of this type of partition to 1½ hr. for the ¾ in. thickness and 2 hr. for 1 in. thickness, the latter rating being applicable for non-bearing constructions only. These constructions, as well as all wood or wood-stud partitions, are rated as "combustible" according to the test specification.

The results with metal-framed hollow partitions (Table 2C) differed little from those with wood-framed partitions insofar as rise of temperature on the unexposed surface was concerned, but the metal-framed partitions usually remained longer as barriers to the spread of fire and afforded no fuel for the flames. These constructions were framed with ¾ in. or 1 in. strip-steel channels and were of the non-bearing type.

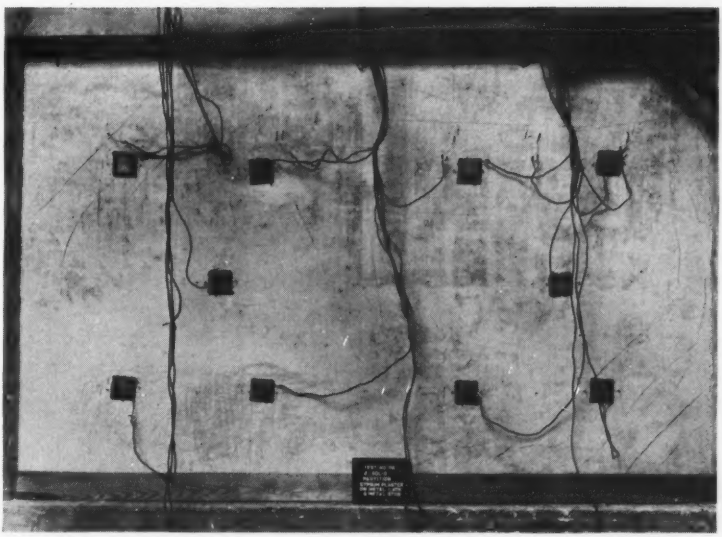


Fig. 5. A 2 in. thick solid partition of wood-fibered gypsum plaster on metal studs and metal lath after 2 hours' exposure of the opposite side to fire in fire-endurance test No. 116.

The solid plaster partitions, also of the non-bearing type, were framed with a single row of metal studs to which the metal lath or other plaster base was attached. With metal lath base and plaster having one part by weight of gypsum to two or three parts of sand, a 2½ in. thickness was required for a rating of 1 hr. (Table 2B) from the standpoint of fire and hose-stream resistance. In point of temperature rise on the unexposed surface the fire resistance was somewhat greater, the 1:2 mix being better in this respect than the 1:2, 1:3 combination for scratch and brown coats, respectively. For these, as for the hollow partitions, the fire resistance for the 2½ in. thickness was increased to 2½ hr. by the use of unsanded neat or wood-fibered gypsum plaster. Similar partitions of 1:2 and 1:3 sanded portland cement plaster, 2 to 2½ in. thick, applied as scratch and brown coats in the usual manner with a trowel, qualified for a rating of ½ hr., the fire resistance being limited by cracking and spalling of the plaster. These effects were even more pronounced with a dense portland cement mortar of 1:4 proportions applied as a spray by means of compressed air, for which the fire-resistance limit with 2½ in. thick partitions was 20 min. However, by substituting sawdust for one-half of the volume of the sand, cracking and spalling were almost entirely prevented and the fire resistance raised to 1 hr. At the end of 1½ hr. fire exposure on this last construction,

application of the hose stream to the heated surface caused only a minor amount of erosion.

The fire resistance ratings given are to be understood as applying to the construction as a whole. Wood framing will be ignited and may be burning freely before failure under load, passage of flame, or other limiting condition is reached. However, from measurements of temperature between the wood studs and fire-exposed facings, information was obtained on the effectiveness of the latter as protection to the wood framing, the general results being given in Table 3 as summarized from the results of one to six tests for each group. The general limits of this protection were found to be from one-sixth to one-third of the fire resistance of the partition as such. The lowest was 5 min. for a facing of ½ in. wood-fiber board and the highest 35 min. for 1 in. of neat wood-fibered gypsum plaster on expanded metal lath. For the same kind and thickness of plaster, the plaster on board bases gave more protection than application on metal lath.

The temperature records (see Fig. 2), as well as appearance of flame, indicated that the wood supports were well ignited at a time no more than one-half of the fire-endurance limit of the partition.

Deflections of wood stud partitions were toward the fire for the first few minutes, after which the movement of the central part was away from the fire. Few of these partitions tested without load deflected more than 2 in. before failure (rise of temperature) had occurred. The loaded partitions deflected more sharply away from the fire during the last part of the test, and most of them failed under load before the limiting temperature rise on the surface had been reached.

Deflections of the steel stud partitions were towards the fire in practically all instances. Those of hollow type framed with two rows of ¾ in. channel studs deflected as much as 5½ to 6½ in., or twice as much as those framed with 3¼ in. wide integral channel studs. The greatest deflections were found in the tests of 2 and 2½ in. solid partitions framed with one row of ¾ or 1 in. channel studs, the average for six with sanded gypsum plaster being 6.2 in., or about 5 per cent of the height. The deflections of five solid partitions of wood-fibered gypsum plaster averaged 5½ in. after exposures averaging over 2 hr., whereas the same deflection was found for portland cement plastered partitions after exposures averaging only 32 min.

With the details of construction employed, which included nailing or tying the uprights into top and bottom plates or runner channels that were anchored into the panel frame, or equivalent details, no collapse from deflection occurred for non-bearing partitions except in one test with a board plaster base insecurely held in sheet metal studs without lateral ties. For bearing partitions the deflections without doubt contributed to the failure under load.

The stability of the partitions was otherwise not affected by the deflections to an extent that decreased the fire resistance below that defined by the other criteria of performance.

Table 1.—Summary of Fire-resistance Ratings for Partitions of Plasterless Types.

Construction Details				
Kind	Framing or Structure	Fill or Membrane.	Facing or Surface	Rating[1]
16 x 10 ft. solid wood panel.	Marginal frame of 2 x 4 in. pine.	None	One thickness of 2 x 6 in. T&G mill flooring.	10 min.
...do	...do	None	Same as above with open joints pointed with gypsum plaster and whitewashed.	10 min.
...do	...do	None	Two thicknesses of ¾ in. T&G ceiling back to back with joints staggered.	15 min.
...do	...do	30 lb. asbestos paper membrane.	Same as above with membrane between board layers.	25 min.
Frame	2 x 4 in. pine studs, 16 in. on centers.	None	¾ in. T&G pine ceiling, each face.	20 min.
...do	...do	Mineral wool fill.	...do	35 min.[2]
...do	...do	Membrane of 30 lb. asbestos paper behind each face.	...do	45 min.[2]
...do	...do	None	½ in. fiberboard, each face (weight 0.7 lb. per sq. ft.)	10 min.
...do	...do	None	½ in. fiberboard, each face (weight 1.2 lb. per sq. ft.)	15 min.
...do	...do	None	½ in. flameproofed fiberboard (weight 1.7 lb. per sq. ft., approx.)	30 min.
...do	...do	None	⅜ in. gypsum wallboards, each face.	25 min.
...do	...do	None	½ in. gypsum wallboards, each face.	40 min.[2]
...do	2 x 4 in. fir studs, 16 in. on centers.	Mineral wool bat fill.	...do	45 min.
...do	...do	Same as above, but nailed.	...do	1 hr.
3 in. thick prefabricated plywood panels.	¾ x 2⅜ in. fir studs, 11⅛ in. on centers.	Mineral wool bat fill, 2 lb. per sq. ft.	¼ and ⅜ in. thick phenolic-resin-bonded plywood.	45 min.[3]
3 in. thick prefabricated steel panels.	2⅜ x 1⅛ in. No. 18 gauge perforated steel channel studs, 9½ in. on centers.	Expanded mica fill, 1½ lb. per sq. ft.	Facings of No. 18 gauge leveled steel plates spot welded to studs.	25 min.
2⅜ in. thick pre-fabricated gypsum units.	Hollow gypsum units reinforced with burlap for full story height. Core spaces 1⅜ x 3 in.	None	Faces of units cast against polished forms, joints pointed after erection.	1¼ hr.[3]

[1] All except last two are rated as combustible.

[2] Not subjected to fire- and hose-stream test.

[3] Tested as 4 x 4 ft. panels without load or hose stream. Hose stream resistance probably not adequate for full rating shown.

Table 2.—Summary of Fire-resistance Ratings of Plaster Partitions.

Plaster Base	Plaster			Rating
	Kind	Mix, Dry Weight		
		Scratch	Brown	
(A) Wood Frame with Facing on Each Side of Thickness "D" Over Combustible Base. Rated As Bearing Partitions, Combustible.				
				$D = ½$ in.
Wood lath or ½ in. fiberboard weighing 0.7 lb/ft.[2]	Gypsum and sand...	1:2	1:2	½ hr.
½ in. fiberboard weighing 1.1 lb/ft.[2]	...do	1:2	1:2	⅔ hr.
⅞ in. flameproofed fiberboard weighing 2.8 lb/ft.[2]	...do	1:2	1:2	1 hr.
Wood lath with mineral-wool fill.	...do	1:2	1:3	1 hr.
...do	Lime and sand.....	1:5	1:7.5	⅔ hr.
Wool lath without fill.	...do	1:5	1:7.5	½ hr.
Wood lath with mineral-wool fill.	Lime, Keene's cement, and sand.	3:1:8 2:1:6	3:1:12 2:1:9	(1 hr.)[3]
(B) Wood Frame with Facing on Each Side of Thickness "D" Over Incombustible or Partly Combustible Base. Rated As Bearing Partitions, Combustible, Except As Noted.				
				$D = ½$ in.	¾ in.	⅞ in.	1 in.
⅜ in. gypsum, plain	Fibered gypsum [5]....	Neat	Neat	1 hr.....	.....	.....	
⅜ in. perforated gypsum.[1]	Gypsum and sand...	1:2	1:2	1 hr.....	.....	.....	
⅜ in. gypsum [3].....	...do	1:2	1:2	¾ hr....	.....	.....	
⅜ in. gypsum, plain, with metal lath pads.	...do	1:2	1:2	1 hr.....	.....	.....	
Expanded metal	...do	1:2	1:3	.....	(1 hr.)[4]..	(1 hr.)[4]..	
Paper-backed metal.	...do	1:2	1:3	.....	¾ hr....	1 hr.....	
Metal	Portland cement, gypsum, and sand.	1 portland:2	1 gypsum:3	.....	.....	1 hr.....	
Expanded metal.....	Gypsum and sand...	1:2	1:2	.....	(1 hr.)[4]..	.....	
Paper-backed metal.	...do	1:2	1:2	½ hr....	1 hr.....	.....	
Expanded metal with mineral-wool fill.	...do	1:2	1:2	.....	1½ hr...	.....	
Expanded metal	Fibered gypsum [5]....	Neat	Neat	.....	1½ hr...	(1¾ hr.)[6]	(2 hr.)[6]
...do	Lime and sand.....	1:4	1:7.5	.....	½ hr....	.....	
...do	Lime, portland cement and sand.	2:1:8	2:1:10	.....	½ hr....	.....	
...do	Lime, Keene's cement, and sand.	2:1:8.5	2:1:13	.....	¾ hr....	.....	
Expanded metal with mineral-wool fill.	...do	1.5:1:10	1.5:1:15	.....	(1½ hr.)[3]	.....	
Expanded metal.....	Portland cement and sand.	1:2	1:3	.....	½ hr....	¾ hr....	
...do	Portland cement, asbestos fiber, and sand.	1:1/30:2	1:1/30:3	.....	¾ hr....	1 hr.....	

See footnotes at end of table.

Table 2.—Summary of Fire-resistance Ratings of Plaster Partitions—Continued.

Plaster Base	Plaster			Rating			
	Kind	Mix, Dry Weight					
		Scratch	Brown				
(C) Steel Frame, Hollow, with Facing on Each Side of Thickness "D" on Incombustible Base. All Rated As Nonbearing Partitions.							
				D=½ in.	¾ in.	⅞ in.	1 in.
Expanded metal	Gypsum and sand...	1:2	1:3	.....	¼ hr....	.....	
...do	Gypsum and calcareous sand.	1:2	1:3	.....	(1 hr.)[3].	.....	
...do	Gypsum and sand...	1:2	1:2	.....	1 hr.....	1¼ hr...	
...do	...do	1:1.5	1:1.5	.....	(1¼ hr.)[3]	.....	
...do	...do	1:1/2	1:1/2	.....	.....	.....	(2 hr.)[3]
...do	Gypsum, sawdust, and sand.	6:1:6	6:1:6	.....	.....	(1 hr.)[3].	
...do	Gypsum and sawdust	7:1	7:1	.....	(1¼ hr.)[3]	.....	
...do	Fibered gypsum [5] ...	Neat	Neat	.....	1½ hr...	2 hr.....	2½ hr.
...do	Portland cement, gypsum, and sand.	1 portland:2	1 gypsum:3	.....	1 hr.....	.....	
...do	Portland cement and sand.	1:2	1:3	.....	½ hr....	.....	
(D) Steel Frame, Solid Partitions of Thickness "D." Incombustible or Partly Combustible Base. All Rated As Nonbearing Partitions.							
				D=2 in.	2¼ in.	2½ in.	
1 in. wood fiber and magnesium oxysulfate board.	Gypsum and sand...	1:1	1:1	¾ hr....	.....		
...do	...do	1:2.5	1:2.5	.....	.....	1 hr.	
¾ in. asbestos lath (soft).	...do	1:2	1:2	¾ hr....	.....		
¾ in. asbestos lath (medium).	Gypsum, sawdust, and asbestos fiber.	86:12:2	86:12:2	.....	(2 hr.)[3] 1 hr...		
Expanded metal or perforated paper-backed welded fabric.	Gypsum and sand...	1:2	1:3	¾ hr....	(1 hr.)[4].	1 hr.	
Expanded metal	...do	1:2	1:2	¾ hr....	(1 hr.)[4].	1 hr.	
...do	Gypsum, sawdust and sand.	6:1:6	6:1:6	(1¼ hr.)[3]	.....		
...do	Gypsum and sawdust.	7:1	7:1	.....	(2 hr.)[3].		
...do	Gypsum and sand...	1:1/2	1:1/2	.....	(2 hr.)[3].		
...do	Fibered gypsum [5] ...	Neat	Neat	1¾ hr...	2 hr.....	2½ hr.	
...do	Portland cement, gypsum and sand.	1 portland:2	1 gypsum:3	.....	¾ hr....		
...do	Portland cement, lime, and sand.	1:1:4	1:1:4	½ hr....	.....		
...do	Portland cement and sand.	1:2	1:3	½ hr....	.....	½ hr.	
Welded fabric 4 x 4 in. No. 6 gauge wire.	Portland cement and sand, dense, sprayed on.	1:4	1:4	.....	.....	⅓ hr.	
...do	Portland cement, sawdust, and sand, sprayed on.	4.5:1:6.9	4.5:1:6.9	.....	.....	1 hr.	

[1] Perforated with holes ¼ in. or larger, 1 hole for not more than 16 in.[2] of area.
[2] Plain lath, indented lath, or lath plain or indented, with perforations not conforming with those referred to in footnote 1.
[3] No hose-stream test.
[4] Hose-stream resistance not adequate according to present test specifications.
[5] The fiber in neat fibered gypsum plasters can be wood, sisal, asbestos, or mixtures thereof.
[6] Rated as non-bearing.

Table 3.—Partition Facings of Boards or Plaster as Fire-protective Finishes Over Wood Framing.

[The plaster mix was proportioned by weight of dry plaster to dry sand.]

Plaster				Kind of Lath	Thickness of facing	Limit as Surface Finish Over Wood		
Kind	Scratch Coat	Brown Coat	Thickness			Maximum	Minimum	Average
			in.		*in.*	*min.*	*min.*	*min.*
None	.....	.....	.....	½ in. fiberboard.....	½	8	3	5½
...do	.....	.....	.....	½ in. fiberboard, flameproofed.	½	.....	.....	12½
...do	.....	.....	.....	⅜ in. gypsum wallboard.	⅜	.....	.....	10
...do	.....	.....	.....	½ in. gypsum wallboard.	½	18½	14	15
Gypsum	1:2	1:2	½	½ in. fiberboard.....	1	.....	.....	21
...do	1:2	1:2	½	½ in. fiberboard, flameproofed.	1	.....	.....	15
...do	1:2	1:2	½	⅞ in. fiberboard, flameproofed.	1⅜	.....	.....	32
...do	1:2	1:3	½	Wood	⅞	17	12	14½
Lime	1:5	1:7.5	½ to ⅝	...do	⅝ to 1	20	14	17½
...do	1:6¼	1:6¼	½	...do	⅞	.....	.....	6
Lime and Keene's cement.	3:1:8 2:1:6	3:1:12 2:1:9	½	...do	⅞	10	10	10
Wood-fibered gypsum.	Neat	Neat	½	Gypsum	⅞	32	24	28
Gypsum	1:2	1:2	½	...do	⅞	28½	21	24
...do	1:2	1:2	½	Perforated gypsum..	⅞	35	26½	30
...do	1:2	1:2	½	Indented gypsum....	⅞	21½	21½	21½
...do	1:2	1:2	½	Indented and perforated gypsum.	⅞	32	25	28
...do	1:2	1:2	⅝	Paper-backed wire or metal.	⅝	21	19	20
...do	1:2	1:3	⅝	...do	¾+	29	19	23
Wood-fibered gypsum.	Neat	Neat	1	Expanded metal.....	1	38	35½	37
...do	Neat	Neat	¾ to 1	...do	⅝ to ⅞	36½	27	32
Gypsum	1:2	1:2	¾	...do	¾	17	13½	15
...do	1:2	1:3	⅝	...do	⅝	14	12	13
...do	1:2	1:3	⅞	...do	⅞	.....	.....	14
Lime	1:5	1:7.5	⅝	...do	¾	.....	.....	10
Lime and Keene's cement.	2:1:6.5	2:1:12.5	⅝	...do	⅝	8	6½	7
Portland cement gypsum.	1:2	1:3	⅞	Wire	¾	.....	.....	8
Portland cement	1:2	1:3	¾ to ⅞	Expanded metal.....	⅝ to ⅞	13	9½	11

Sodium Chlorite.

Sodium chlorite is a new commercial chemical recently brought into quantity production by the Mathieson Alkali Works. This chemical, used for bleaching textiles and paper, has not yet been considered by the N.F.P.A. Committee on Hazardous Chemicals and Explosives, but information on its properties and hazards has been made available by the manufacturers, who should be commended for calling attention to the hazards of their product so that users may take appropriate precautions. The following data are based on a paper on the Properties and Reaction of Sodium Chlorite, presented before the 99th meeting of the American Chemical Society, by representatives of the Research Department of the Mathieson Alkali Works.

Sodium chlorite is the intermediate member in the series hypochlorite, chlorite, chlorate as indicated by its formula:

$NaClO$ — Sodium hypochlorite
$NaClO_2$ — Sodium chlorite
$NaClO_3$ — Sodium chlorate.

In many respects the properties of sodium chlorite are intermediate between the hypochlorite and the chlorate. The chlorite is more stable than the hypochlorite but less stable than the chlorate.

The property of the sodium chlorite which forms the basis of its more important uses so far developed is its oxidizing power. In cold alkaline solutions it has only a mild oxidizing agent, but heating or the presence of acid in chlorite solutions produces a strong oxidizing condition. The chlorite is a stronger oxidizing agent than sodium peroxide. It is stronger than sodium chlorite in dilute acid solutions.

This new bleaching and oxidizing agent had been found to be relatively stable, although it decomposes at 175° C. (347° F.). The heat of decomposition then raises the temperature to approximately 340° C. (644° F.).

As with sodium chlorate, the chlorite when mixed with any organic material, acid or ammonium compound, is particularly hazardous because of the ability of such substances to be reduced. A mixture of sodium chlorite with sugar bursts into flames when heated to a temperature of approximately 200° C. (392° F.).

It is this same property of sodium chlorite that causes it to explode in some instances. In experiments with the substance in pure form, there is no reaction when hit with a hammer. If, on the other hand, a slight bit of organic material such as oil or grease is placed on the head of the hammer an explo-

sion occurs. This explosion is the result of an extremely rapid oxidation of the organic matter brought about by forceful sudden contact with sodium chlorite.

Hazards of Sodium Chlorite.

Impurities, particularly those of an organic nature, in sodium chlorite might make the substance extremely hazardous. Another hazard is known to exist when sodium chlorite in solution is allowed to saturate clothing and then to dry. Such clothing will burst into flame with little provocation.

A serious fire hazard is known to arise when chlorate solutions are allowed to dry on clothing. Similar hazards exist in the case of chlorite. Timing the burning of measured strips of tape showed that impregnation with low concentrations of chlorite followed by drying caused slower burning than equal quantities of oxygen from chlorate. Stronger solutions caused the chlorite-impregnated samples to burn more rapidly than comparable impregnation with chlorate. The use of cotton gloves in handling chlorite is hazardous.

When introduced into the stomachs of guinea pigs, chlorite was found to be toxic. On the basis of these experiments, 5 to 6 grams of sodium chlorite would produce toxic effects in the average adult man, and twice this amount would be lethal. Hypochlorite apparently is destroyed by reacting with membranes, while chlorite is stable enough to enter the blood stream.

Chlorite reacts with sulphur in a unique manner. A mixture of sulphur and solid chlorite will ignite if rubbed or slightly moistened. There is enough sulphur in a rubber stopper to cause a slight pop when rubbed on moist chlorite. Bottles containing chlorite should be closed with cork or glass stoppers. The use of articles of clothing made of sulphur-bearing rubber is hazardous. The use of neoprene avoids this danger.

In contact with strong acids, sodium chlorite emits chlorine dioxide, which in itself is a highly hazardous gas and explosive under certain conditions. In addition, the gas is irritant, as is chlorine. Men working in an atmosphere in which there is a possibility of contamination with chlorine dioxide should be equipped with gas masks, and adequate ventilation should be provided. It is more intensely colored than chlorine and has a noticeable odor, so that its detection in low concentrations in the atmosphere is relatively easy.

The similarity of sodium chlorite to the chlorate would indicate that pending the development of further information, the recommendations for the handling of sodium chlorate in the N.F.P.A. Table of Common Hazardous Chemicals might be applied to the chlorite. These recommendations refer to isolation from combustible materials, acids and sulphur, and state that water is the best extinguishing agent.

Boston Warehouse Fire.

By P. C. Charnock and Nelson F. Gamage.*

Shortly before 6:00 P.M. on September 18, 1941, a fire, soon to reach conflagration proportions, broke out at the southwest end of Freight House 35, located at 470 Rutherford Ave., one of numerous such sheds in the Charlestown district of Boston belonging to the Boston and Maine Railroad and occupied by various tenants.

According to statements by two watchmen for the principal tenant and by other eyewitnesses who were early at the scene, the fire when first noticed did not appear to be serious, but by the time an alarm had been given and the fire department had arrived the shed of origin was extensively involved.

With this formidable start the fire, against stubborn fire department resistance, spread to and beyond adjacent buildings until it had become Boston's worst in over 30 years, necessitating the sounding of five alarms and summoning the aid of surrounding cities and towns, again demonstrating the danger of inadequate protection against serious exposure.

The fire entirely destroyed the building of origin, Freight House 35, and Freight Houses 32, 33, 34, exposed on the south (see map). To the south of Freight House 32 the heat cracked practically every pane of plain glass and blistered considerable paint on steel rolling doors on the northerly side of the fireproof Fruit Terminal Building. In addition nine truck trailers without tractors, all of which contained freight, were totally destroyed; eight of these were ready for unloading at Freight House 35 and one was at Freight House 33. Twenty-eight box and refrigerator freight cars on sidings were involved, 15 being totally destroyed and 13 being damaged. A few other miscellaneous sheds, numerous telegraph poles and a 4000-volt power line, property of the Boston and Maine Railroad, were destroyed. Buildings of low height on the easterly side of Rutherford Ave. were slightly scorched and some glass broken or cracked. No fire entered these buildings.

The frame building at 290-300 Rutherford Ave., approximately 1400 feet south of Freight House 35, was extensively damaged by a fire which was believed to have been caused by flying brands from the main fire, although the fire department reports indicate this to be a separate fire.

While the losses have not been adjusted, it is believed the loss will probably exceed $1,300,000.

*Mr. Charnock is Assistant Manager, and Mr. Gamage Inspector of the New England Fire Insurance Rating Association (Member N.F.P.A.).

Construction.

Freight House 35, where the fire started, was a one-story frame shed with a 3-inch plank floor on timbers and posts 4 feet above ground. The open space under the building was enclosed with wire mesh. It was 60 feet wide by 620 feet long and had a ceiling height of 18 feet. The roof was 1-inch plank on light joist covered with tar and gravel. There were 8 transverse, metal-clad fire partitions dividing the shed into nine sections, eight being about 65 feet and one about 100 feet in length. There were no parapets, wing walls or sub-structure fire divisions. Each partition had two openings with metal-clad doors hung on wood frame, but few, if any, of these doors were closed at the time of the fire.

Freight Houses 34, 33 and 32 were of similar construction and approximately the same size as 35.

Protection.

All of the buildings involved were equipped with ordinary first-aid protection only.

First National Stores, Inc., the principal tenant of Freight Houses 32, 33, 34 and 35, maintained watch service, reporting on a portable clock.

A watch station located inside the extreme end of the last section of Freight House 35, where the fire started, was visited at 5:13 P.M., about 45 minutes before the fire was discovered.

The water supply for this area is from the Low Service from the Metropolitan District water system. A 16-inch main passes the burned area on the front and a 12-inch on the rear. Both are well supported from other arterial feeders and interconnected by 6- and 8-inch mains. Pressures are approximately 55 pounds. Hydrant spacing is frequent, but many in the rear are not accessible for pumping engine supply.

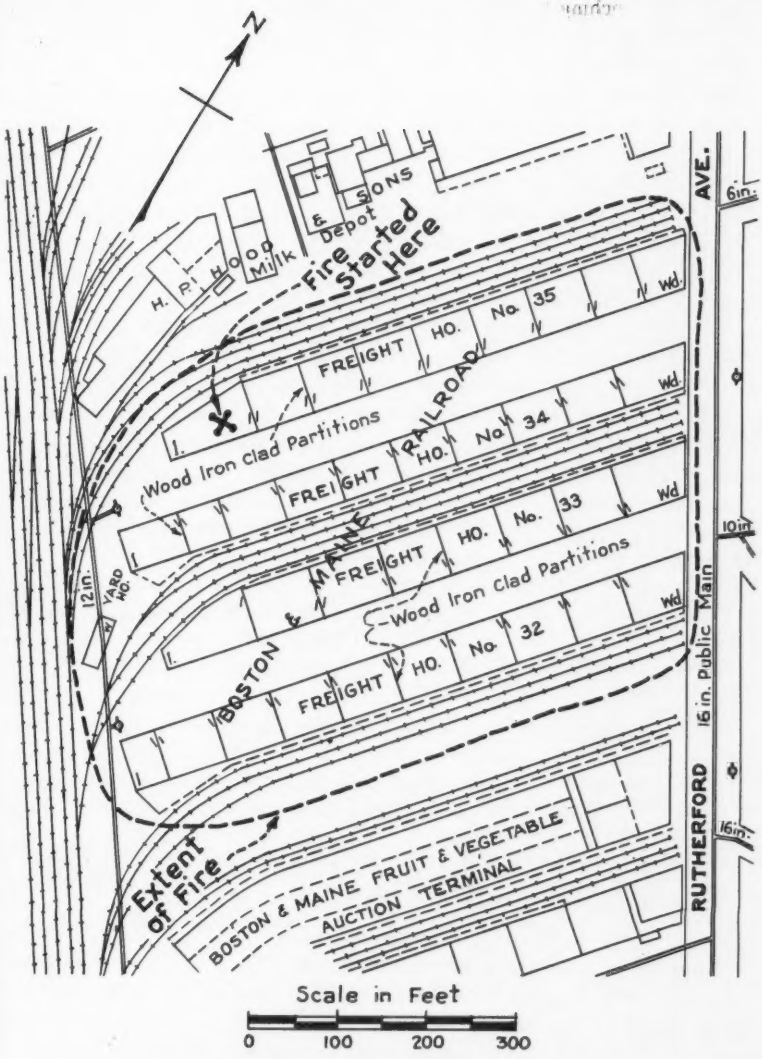
Two fire department stations are located within one-third of a mile.

Occupancy.

Freight Houses 33 and 35 were entirely occupied and 32 and 34 were partly occupied by First National Stores, Inc., chain retail grocers, for storage of surplus canned foods. Other tenants used the balance of Houses 32 and 34 for the storage of building materials, plumbing and roofing supplies and other materials.

Discovery of Fire.

According to the watchman's clock used by the watchman for the First National Stores in Freight Houses 34 and 35, the last visit of the watchman in Freight House 35 at the westerly end was at 5:13 P.M. This watchman stated at this time there was no indication of fire or anything out of order. He then passed through the entire length of Freight House 35, checking the closure of loading doors. Following a short rest period he started his rounds in Freight



PLAN OF THE FIRE AREA.

In addition to the fire area shown on this plan, a large frame building 1400 ft. south of the start of the fire was also partly destroyed. This plan shows only one set of doors in each of the partitions in Freight House 35; actually there were two sets in each partition.

House 34, punching his clock at the westerly station in this freight house at 5:43 P.M. He returned to the entrance to the freight house about midway in the length of the building and on his exit noticed smoke rising above the westerly end of Freight House 35. His view was considerably obstructed by trailers in the driveway and because of this he was of the opinion the smoke came from a locomotive and hesitated in making an investigation or sounding an alarm. Finally realizing this was an actual fire, he attempted to reach a fire alarm box on the opposite side of Rutherford Ave. but was delayed because of continuous traffic on this thoroughfare. He saw someone at the fire alarm box, concluded an alarm had been sounded and returned to Freight House 35 to notify his employer by telephone.

Another watchman employed by the First National Stores, who at the time was at Freight House 28, noticed smoke in the vicinity of Freight House 35, ran to that point and reported finding a fire involving one of the trailer trucks at the westerly end of this freight house and flames attacking the walls of the building. He also attempted to sound an alarm from the fire box on Rutherford Ave., but found someone else had preceded him. In the meantime, an employee of the Columbia Radiator Company in Freight House 34 discovered the smoke and telephoned the fire department. No definite cause of the origin of the fire has been determined.

The record of fire alarms is as follows:

5:59 P.M.—Telephone alarm from employee of Columbia Radiator Company in Freight House 34.

6:02½ P.M.—Box alarm from Box 4156 at Rutherford Avenue and Essex Street.

6:06 P.M.—Third alarm (second alarm omitted).

6:07 P.M.—Fourth alarm.

6:08 P.M.—A.D.T. alarm from Fruit Terminal Building.

6:12 P.M.—Fifth alarm.

6:27 P.M.—Call for all available Boston apparatus.

6:38 P.M.—Alarm from Box 4137 at Rutherford Avenue and Dunstable Street, for fire at 290-300 Rutherford Avenue.

6:53 P.M.—Call by commercial radio stations for off-platoon to respond to fire stations.

6:53 P.M.—Police teletype message calling for aid from adjacent municipalities.

8:50 P.M.—Call for off-platoon to report to fire.

Story of the Fire.

On receipt of the telephone alarm, Engine 32 and Ladder 9 with a District Chief Officer responded. These companies were located within 1400 feet of the fire. The telephone message indicated the fire was in a shed in the rear of the H. P. Hood Milk Co. plant just north of Freight House 35. Engine 32, the first company to arrive at the fire, proceeded to the rear of the Hood plant and found the fire was in Freight House 35 and of considerable proportions, with flames issuing underneath the eaves of the Freight House and involving a line of freight cars on the sidings adjacent to Freight House 35. They laid

International.

The fire as seen by the pilot of an American Airlines plane, looking south, at about 6:30 p.m., only about half an hour after the discovery of the fire.

two lines into a turret pipe and stretched a single line on top of the freight cars. Members of Ladder Company 9 reported they found two of the loading doors on the easterly end of Freight House 35 opened (these were reported opened by the watchman with the idea of facilitating work of the fire department). An attempt was made on the part of the Ladder Company to open other doors nearer the scene of the fire, but it was found the entire interior of the freight house was then involved and this work was discontinued.

With the arrival of the first alarm apparatus, which included, in addition to that already responded, Engine Companies 27 and 50 and Ladder 22, it was reported these additional Engine Companies attempted to take up a stand between Freight Houses 34 and 35, one company laying a single line, the other two lines, but in approximately two minutes, because of the intensity of the heat, they were driven from this position, as by this time the westerly end of Freight House 34 had become involved. From then on it was reported the fire spread rapidly, enveloping Freight Houses 35 and 34, and soon attacked the westerly end of Freight House 33.

Apparently the amount of fire involved is indicated by the fact that the District Chief Officer immediately called for a third and a fourth alarm, followed very quickly by the fifth alarm, and soon after, the response of all available Boston apparatus. It was said the fire was so intense it was impossible to negotiate lines between any of the freight sheds, but a stand was taken from the fire-resistive Fruit Terminal Building, where numerous hose streams were

International.

An air view of the ruins at dawn. At the right are the ruins of the warehouse where the fire started. At the upper left may be dimly seen the outline of the fire-resistive fruit warehouse, where the further spread of the fire was stopped.

played from the roof of this building. Many other lines were directed from vantage points on Rutherford Ave.

Difficulty was encountered in utilizing hydrants at the westerly end of the freight houses due to the amount of heat and, secondly, because of no roadway other than the roads between the freight houses, this entire area to the west being taken up with railroad sidings. Some pumpers, however, were driven over the tracks and operated from these hydrants in the later stages of the fire.

Numerous men with brooms and mops were said to have been fighting flying brands landing on the roofs of buildings south of the Fruit Terminal Building, many of which were reported to have fallen on the building at 290-300 Rutherford Ave., which became involved at 6:38 P.M. The alarm for this fire was received at the fire alarm office but was not transmitted to the fire stations. A District Chief at the main fire was notified of the second fire and he dispatched six Boston companies and six engine companies who had at this time responded from adjacent municipalities.

No coherent story can be told from this point on, other than to indicate the fire department understood a disastrous fire was on hand and every attempt was made in playing lines on the buildings on the easterly side of Rutherford Ave. to prevent the spread of fire to thickly built, frame tenement sections which were seriously exposed. The fire was well under control by 11:00 P.M.

Except for the fact only an engine company and a ladder company responded on the telephone alarm, and these with the additional companies responding on the fire box alarm were undermanned, there ultimately appeared to be an adequate number of men and apparatus on hand to cope with any kind of emergency.

The number of men responding on the telephone alarm were as follows:

Engine 32—5 men and 1 officer.
Ladder 9—4 men, 1 officer and 1 District Chief.

Those responding on the first alarm, 3½ minutes later, were:

Engine 27—3 men and no officer.
Engine 50—4 men and 1 officer.
Ladder 22—5 men and no officer.

The following is the response of apparatus to the various alarms in Boston:

Telephone call—1 engine, 1 ladder and District Chief.
First alarm—2 additional Engine Companies and 1 Ladder Company.
Third alarm (including second alarm)—11 Engine Companies, 2 Ladder Companies, 1 water tower, 1 District Chief and 1 Division Chief.
Fourth alarm—5 Engine Companies, a Ladder Company, a District Chief.
Fifth alarm—5 Engine Companies.
Call for additional apparatus—12 Engine Companies, water tower, 3 Ladder Companies, and a Rescue Company.

dimly seen the outline of the fire-resistive fruit warehouse, where the further spread of the fire was stopped.

From 6:01 P.M. to 10:17 P.M. the fire alarm office reported seven box alarms were received in addition to six still alarms, and that office estimated from 6:00 P.M. to 11:00 P.M. that 10,000 messages had been handled by five fire alarm operators.

Soon after the start of this fire the City of Somerville, adjoining, received a box alarm on their system and on arrival found it was for a fire in Boston. One of their engine companies immediately proceeded to the fire; the others returned to their quarters, but because of mutual aid arrangements were immediately ordered to the fire, since at that time the third alarm from Boston had been received over the Boston fire alarm circuit. Other adjacent municipalities connected to the Boston fire alarm system, on receipt of the third alarm, requested directions as to their procedure. These were all notified to proceed to various vacated fire stations in the City of Boston.

As a result of the appeal over the radio for members of the off-platoon of the Boston fire department to return to their stations and the notice over the police teletype, the records of the fire department show the following municipalities near by and as far as 35 miles distant sent apparatus to the fire or were directed to locate at vacated stations throughout the city:

Apparatus Responding from Municipalities Outside of Boston.

To the Fire	*Filling in at Fire Stations*
Wakefield—1 engine	Arlington—1 engine at Engine 34 and 51
Chelsea—2 engines	Dedham—1 engine at Engine 27
Lowell—2 engines	Milton—1 engine at Engine 48
Revere—1 engine	Revere—1 engine at Engine 9
Weymouth—Chief and 6 men	Lynn—1 engine at Engine 4
Medford—1 engine and rescue truck	Norwood—1 engine at Engine 30
Haverhill—1 engine and chief	Quincy—1 engine at Engine 20 and 46
Waltham—1 engine and chief	Somerville—1 engine at Engine 6, 32, and 4
Somerville—2 engines	Brookline—1 engine at Engine 33 and 28
Reading—1 engine and chief	Newton—1 engine at Engine 41, 37 and 22
Melrose—1 engine	Everett—1 engine at Engine 50
Everett—1 engine	Needham—1 engine at Engine 30, ordered returned immediately.
Malden—1 engine and hose wagon	
Stoneham—1 engine	Watertown—1 engine at Engine 27
Belmont—1 engine	
Cambridge—2 engines and chief	

The City of Lynn also sent an engine to cover in at a Malden station; Malden sent an engine to cover in at Somerville; Medford also sent an engine to cover in at Somerville. (Other transfers of apparatus of outside communities are believed to have been made, but at the time of this report all data had not been received.)

The apparatus responding to the fire from the City of Boston and other communities totaled 55 engine companies, one hose company, eight ladder companies, two water towers, two rescue companies, and nine Division or District and outside chiefs in addition to the acting chief from Boston.

The fire spread rapidly from warehouse to warehouse. This picture, looking northward across Rutherford Ave., shows the third of the four warehouses completely involved, and the fire spreading rapidly to the fourth.

Weather Data.

Records of the United States Weather Bureau from readings taken at the East Boston Airport, a distance of about two miles from the fire, show that the temperature at the start of the fire was 76° F. Two humidity readings taken at 1:30 P.M. and 7:30 P.M. were 26 and 34 per cent respectively. Between the hours of 5:00 P.M. and 6:00 P.M. the wind was northerly at 14 miles per hour, changing to northwest at 12 miles per hour between the hours of 6:00 P.M. and 7:00 P.M. It remained at approximately the same velocity and direction throughout the course of the fire.

Conclusions.

This fire illustrates the fallacy of storing large values of goods in structures of inferior types, closely grouped and without the benefit of automatic sprinklers or automatic fire alarm. Had the fire doors on the fire partitions been closed, the fire probably would have been confined to the section where it originated.

Apparently there must have been considerable delay in the discovery of the fire, as members of the fire department who were on their way to report for duty at 6:00 P.M. at Station 32 stated they noticed smoke from the vicinity

of the fire, and others on duty at this station stated they had observed smoke from this area for some minutes before receiving the alarm.

One point in the spread of the fire may be laid to the fact that as the first notice to the fire department was by telephone, only an engine and a ladder company were dispatched. This should have commanded a full complement of first alarm engine and ladder companies, the same as is practiced after 11:00 P.M. Another point was that on the telephone alarm and on the first alarm the companies responding were inadequately manned, one engine company having only three men and no officer, and others having five or six men, one having no officer in charge.

A strong water distribution system with static pressures of about 55 pounds was available, and apparently there was ample water available from the water system, as no indication is given of an inadequate supply to engines.

That the fire was finally confined to the four freight sheds and the one fire just outside of the main fire area and did not reach the thickly built-on tenement area to the east was due in good part to the presence of the fire-resistive Fruit Terminal, which permitted the fire fighters to make a stand, and that finally large numbers of Boston companies with outside assistance had surrounded the fire.

However, it seems most inappropriate with the number of fire companies available in Boston and with prearranged mutual aid arrangements, to call for assistance from communities as far distant as those which responded to the teletype call, and some of which could ill afford to render assistance at such distances. That so many communities were willing to respond to the calls for aid is commendable, but, on the other hand, the protection to their respective municipalities was in some cases seriously affected and presumably the large amounts of apparatus sent to Boston could not be effectively utilized.

Cleveland Aluminum Foundry Fire.

One of the most telling blows which has thus far slowed the national effort to speed up defense production in the United States resulted from a fire which destroyed the large unsprinklered main foundry building of the National Bronze and Aluminum Foundry Company in Cleveland, Ohio, on the morning of September 30, 1941. Company officials reportedly have estimated the loss at $2,250,000. However, this large sum does not account for the important indirect losses. Most of the work at the plant was in connection with defense contracts and included the manufacture of airplane engine castings. The loss in production will be large. Although negotiations for plant space started immediately and the plant was in limited operation a week later, it is estimated that it may be three months or more before full production can be resumed.

The plant was mostly a one-story steel frame structure with corrugated or steel siding. Most of the roof construction consisted of plank on steel frame. With two minor exceptions there were no division walls to subdivide a single unsprinklered area of nearly 118,000 sq. ft., roughly 350 ft. by 420 ft.

A new aluminum foundry section along almost the entire eastern side of the original foundry building had just been completed. This new unit was of similar construction with the exception that the roof was of insulated steel deck construction. A small heat treating unit at the west side of the plant had a roof of uninsulated steel deck construction. A one-story brick office building having a wooden joist roof adjoined the main foundry at the north side. The office section was the only area cut off by a wall, and there were numerous unprotected openings here.

The foundry was engaged in the manufacture of rough aluminum castings for airplane engines and other defense products using both ingot and scrap metal. Some of the items were manufactured in the foundry proper, but most of the defense production requiring added space was to be done in the new aluminum foundry section. A considerable amount of equipment had been moved into this non-combustible building on the day preceding the fire.

Equipment in the plant, typical of an aluminum foundry, included metal and wood patterns, molding machines, a sand blasting outfit, sand mixer, hoists, flasks, bottom plates, sand handlers, air compressors, heat treating furnaces, core ovens, water testing machines, and "target machines" for gauging the accuracy of the castings.

An area about 100 ft. long and 50 to 100 ft. wide in one corner of the main foundry near the new aluminum foundry was used for the storage of aluminum ingots and scrap, which had accumulated in an unusual quantity owing to the

International.

The layman might have thought that there was nothing to burn in this building, but a concrete or dirt floor, a steel frame and the apparently non-combustible occupancy of a foundry do not make a building "fireproof," as this picture shows all too clearly.

Acme.

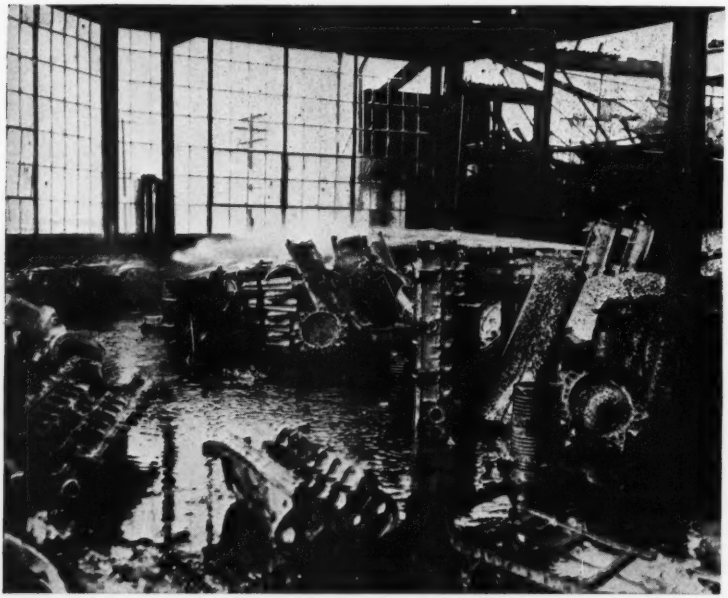
Fire in the plant of the National Bronze and Aluminum Foundry Company, Cleveland, on September 30, 1941, caused damage estimated at up to $2,250,000, destroyed parts in process for airplanes and tanks, and destroyed the machinery for this vital defense production. The building was some 118,000 square feet in area without subdividing fire walls and without sprinkler protection. The best efforts of a large and efficient fire department could not prevent complete destruction under such conditions.

breakdown of a smelter. The scrap consisted of bales of old sheet products, old castings, chips and turnings. Most of these chips were stored in bins with steel walls but without roofs or tops. Some chips were received in burlap bags and these were stored bagged in a pile some 15 feet high. There was evidence after the fire that chips and turnings were oily and that the burlap bags were well saturated with oil.

Story of the Fire.

The fire started in the corner of the main foundry building where the oily chips and turnings were stored. Employees attempted to extinguish the fire with two soda-acid extinguishers without success.* The fire spread rapidly through the oily aluminum scrap and the burlap bags, filling that portion of the plant with thick black smoke, and the employees were apparently unable to locate the manually operated central station fire alarm boxes with which the

*A small fire in the plant the night before had been put out with extinguishers without calling the fire department.



Acme.

The wreckage of one section of the plant. Special castings for airplanes and tanks are easily warped and made unfit for use by fire heat and sudden cooling by hose streams.

plant was equipped. An alarm was telephoned to the public fire department at 11:10 A.M. Before the arrival of the first two engine companies the fire had spread to a large portion of the outside of the plank and timber roof which had recently been mopped with tar. Upon the arrival of the first apparatus a third alarm was ordered immediately, at 11:16 A.M., followed at 11:27 A.M. by a fifth alarm. Four minutes after the fifth alarm another call was sounded. These alarms brought a total of fourteen engine companies and three ladder companies.

A south wind with a velocity of about 25 miles per hour carried the fire across the plant, which was practically destroyed in an hour and a half.

Extent of Damage.

Practically everything in the wood roofed main building, whether combustible or non-combustible, was destroyed or rendered unusable. The office building was damaged, and some important records were destroyed. One end of the heat treating section, adjoining the main plant, buckled from the heat. A portion of the new aluminum foundry also failed, and most of the roof insulation was burned off this section. The entire length of the insulated steel roof deck was said to have been seriously affected.

The contents of the new foundry were subjected to heat, water and melted roof insulation. Metal patterns, flasks and bottom boards that were apparently not damaged all required cleaning, inspection and checking. The molding machinery which did not appear to have been greatly damaged was oiled after the fire and was cleaned and oiled the following day.

Other equipment in the new area suffered varying degrees of damage. Due to the accuracy required of the work, this equipment will need careful checking before it is passed for future use. In general all items not completely destroyed will require cleaning, checking or both, and many will require repairs, as the rough castings must be kept within close tolerances to fit the automatic machinery.

Cause and Conclusions.

It is reported that the cause has been determined by plant officials to have been spontaneous ignition in the oily aluminum chips and turnings. The initial spread of the fire may have been accelerated by the use of soda-acid extinguishers on the burning scrap. Water or a water solution extinguisher is not suitable for fire in finely divided aluminum, and may in fact intensify the combustion. Sand or some other inert smothering material is the recommended extinguishing agent for such fires. The presence of burlap bags complicated the problem in this case, and the employees probably should not be blamed for the use of the soda-acid extinguishers, as this is a proper type to use on burning burlap. The hazard of scrap aluminum could have been decreased by removal of the scrap from the bags. However, in any case, aluminum scrap should not be stored in manufacturing areas but in detached noncombustible buildings.

There is no evidence of any explosions from the action of the water on the burning aluminum, which would indicate that the fire department used discretion in directing hose streams. It is probable that the greatest factor in the rapid spread of the fire was the strong south wind; the fire started in the southeast corner. It is probable that there was some delay in calling the fire department, which contributed to the great headway of the fire when the first apparatus arrived. After fire is well under way in a building of such large area, it is not to be expected that any fire department can prevent very heavy loss.

This fire demonstrates the hazard to property and to continuity of production by the lack of sprinkler protection under combustible roofs. It also appears that separation of important areas by adequate fire walls would have resulted in a much less serious loss. This plant could have been subdivided by fire walls so as to separate the new aluminum factory, core room, cleaning and inspection department and office building from the main foundry.

Exolon Co. Fire, Blasdell, N. Y.

Report by E. L. Ballard (Member N.F.P.A.),
Eastern Underwriters Inspection Bureau.

The Exolon Company, Inc., of Blasdell, New York, near Buffalo, was an abrasive finishing plant. Until destroyed by fire on the evening of August 18, the plant was producing abrasive products vital to national defense. The loss was over a million dollars. The direct fire loss was estimated at $575,000, and the use and occupancy loss at $500,000 to $650,000. Owing to the difficulty of replacing destroyed machinery, it may be six months before full production can be resumed.

Construction and Protection.

The plant buildings were mostly of frame construction, steel clad, one to four stories in height. Floors and roof were of open joist. Stairs and other floor openings were open and unprotected against the spread of fire.

The plant was protected against fire by a dry pipe sprinkler system. However, the sprinkler system took its water supply from the small mains of the village water system. This water system at best could provide a total supply of only 600 to 800 gallons per minute to the sprinkler system and hydrants in the vicinity. This was obviously not enough water to protect such an important plant. With a flow of only 400 gallons a minute, the pressure in the system dropped from a normal static pressure of 90 pounds to only 37 pounds. At the time of the fire foundations were completed for a 50,000-gallon water tank at the plant in order to supply sprinklers. If this supply had been available this large loss should have been prevented.

The Story of the Fire.

On the night of the fire the plant was in operation with some sixteen men working. At about 7:50 P.M. an employee on the third floor detected smoke. Investigation located a small fire in a hollow wooden partition between the first and second floors. It is believed that ignition was due to heat from an oil-fired roaster about four feet from the partition. A similar fire due to the ignition of a hollow partition by a gas-fired drying pan had occurred on March 1, 1941, but was extinguished with a loss of about $1000. The hollow wooden partitions were steel clad, but the steel covering did not prevent the ignition of wood by long continued heat.

Sprinklers were not operating when the fire was discovered, but came on a minute or so later in both the first and second floors. For about fifteen minutes the sprinklers held the fire in check, but they could not extinguish the

International.

This defense plant at Blasdell, New York, was wiped out by fire. Production of important war materials was reduced to less than five per cent of what the plant was turning out before the fire. Several months will pass before the plant can be replaced and production resumed. It is reported that the Office of Production Management in Washington is struggling with the problem of providing some relief to customers depending on the burned plant for essential abrasive products. The automatic sprinklers protecting the plant failed largely because fire department pumpers took all of the available water.

flames in the hollow partition and the continued heat of the fire opened several more sprinklers farther away.

About this time the Blasdell Volunteer Fire Department took a stream from a private hydrant, using a 1⅛-inch nozzle. This stream was weak and probably only served to reduce the flow from the sprinklers. A few minutes later the department's pumper took suction from this hydrant and supplied a 1-inch nozzle inside the building until driven out by fire and smoke.

At 8:09 P.M. the plant manager called the Lackawanna City Fire Department, which sent a pumper and aerial ladder. This pumper also took suction from a private hydrant on the same weak water system which was supplying the sprinklers. A 1¼-inch nozzle used from the aerial ladder proved ineffective and a 1-inch nozzle was then used elsewhere.

At 8:23 P.M. the manager called the Buffalo Fire Department. The captain of the first Buffalo pumper to arrive immediately called more help. He appreciated the fact that the limited water supply was all needed to supply the sprinklers and started relaying water from the point where the village water system gets its supply from 16- and 24-inch mains. The first Buffalo pumper was supplied through 1000 feet of hose by the pumper of the Bigtree

Volunteer Department (another volunteer fire department responding to the call for assistance) and was able to do effective work. Two additional Buffalo pumpers formed a second relay which gave a good stream through a 1-inch nozzle. With this help the firemen made a stand and saved the company office and several other buildings. It is significant that there was apparently no prearranged plan for handling fire emergencies such as this, and the calling of outside aid depended upon the initiative of the plant manager.

Middletown, Conn., Group Fire.

At 8:29 P.M. on Friday, August 29, the fire department of Middletown, Conn., received a still alarm from a restaurant near the corner of Court and Main Street in the heart of the city's business section. When two pieces of apparatus arrived on the scene a few minutes later the interior of the store was a blazing cupola, flames were shooting from the roof and the fire was beyond control. Before extinguishment was completed, nine buildings had been gutted; a loss of $250,000 had been sustained.

Building Construction.

The building housing the restaurant in which the fire started was of brick-joisted construction with a wooden interior and was three stories in height. The other eight buildings to which the fire spread were of the same type of construction, varying in height from one to four stories. Most of the buildings were connected, but fire walls and other details of fire protective construction had been entirely neglected. None of the buildings was sprinklered.

According to the chef of the restaurant, who was present when the blaze got underway, a pan of burning grease dropped from his hands as he took it from an oven. Almost instantaneously the kitchen floor was fired and the flames had spread to clothing hanging on the walls and to the walls themselves. For a matter of 25 minutes, the chef reports he and the woman owner of the restaurant tried to beat out the flames, but their efforts were only met with a spreading of the fire to the second floor through an open stairway and thence to the roof. It was then that the first alarm was transmitted to the fire department.

Fighting the Fire.

On duty in fire department stations of this city of 26,000 population when the first alarm was received was a total of seven men, of whom six went to fight the fire with three engines and an aerial ladder. They were soon joined by some of the 157 members of the South District Association Volunteer Com-

Acme.

The corner of Main and Court Streets in Middletown, Conn., where fire, on the night of August 29, gutted nine buildings at a loss estimated at $250,000. The fire started in a restaurant on the ground floor of the three-story building on the extreme right and spread rapidly to eight other buildings of inferior construction lacking fire protection.

pany, although the exact number of men cannot be determined, since members of this company do not report themselves present when they respond to alarms.

About a half hour after the first alarm had been sounded aid from other cities was called, and apparatus soon arrived from Portland, Westfield, Meriden, Hartford, Cromwell, Durham and Clinton. The departments of East Hampton and Haddam also sent apparatus to cover the vacated stations of Middletown.

The flames spread rapidly to the other eight buildings along Court and Main Street, and in one place they bridged an alley eight feet wide, although there was no high wind on the night of the fire.

Conclusions.

Last year N.F.P.A. engineers pointed out to the authorities that this city needed more paid firemen for adequate fire protection. It is obvious that more than six well-trained men are needed to cope with a fire of this size. This is particularly true if entire blocks of the city are of brick-joisted construction with wooden interiors and no means of fire protection.

The department might not have been at nearly so much of a disadvantage had the alarm been sounded from the restaurant as soon as the fire had started.

Fires in Which There Was Loss of Life.

Third Quarter, 1941.

During the Third Quarter there were eight fires in which there were five or more lives lost. These fires were as follows:

JUNE 29, 1941, BAILEY ISLAND, MAINE. Burns on the bodies of the 20 men and 17 women which were washed ashore in the vicinity of this island, and charred bits of wreckage convinced authorities that Maine's worst coastal tragedy of the century, that of the cabin cruiser *Don*, resulted from an explosion followed by fire on the small vessel. The catastrophe was neither seen nor heard by anyone on the mainland, for fog shielded the boat from view. None of the party of 37, which was headed for a picnic on Monhegan Island, was found alive. (H-44034.)

JUNE 30, 1941, INDIANA, PENNA. A dust explosion in a mine near this town killed six men and injured 17. (H-44035.)

JULY 7, 1941, LEEDS, ALA. Hope was abandoned for the lives of ten men following a mine explosion which occurred near here. It was believed that the men were at least a mile from the mouth of the slope mine. (H-44036.)

AUGUST 10, 1941, DOYLESTON, PENNA. Five sleeping children perished in flames which turned their home into a raging furnace. The use of a kerosene stove by the mother to heat water for the children's Saturday night bath was believed to have caused the fire. (L-06519.)

AUGUST 10, 1941, WAYNESVILLE, MO. Eight negro soldiers riding in an Army truck and the white driver of a large transport truck were killed near here following a side-swiping collision in which an auxiliary gas tank on the side of the transport was injured and flaming gasoline was showered over the men. (H-44037.)

AUGUST 18, 1941, NEW YORK, N. Y. A sweeping fire which started aboard a cargo ship and spread to the wharf where it was docked claimed the lives of 34 men who were working in and about the ship at the time. See report, page 121. (H-44038.)

AUGUST 18, 1941, PUNXSUTAWNEY, PENNA. Six sleeping children were victims of a fire in their home following a soot explosion in the kitchen. A neighbor tried unsuccessfully to rouse the children when she discovered the fire, then ran half a mile to the nearest telephone to call the fire department. (L-06520.)

AUGUST 25, 1941, WALDWICK, N. J. Seven persons died here when a 38-passenger bus plowed into four parked automobiles and burst into flames. One other person was severely burned. (L-06521.)

Foreign Fire.

JUNE 6, 1941, GUADALAJARA, MEXICO. Eighty-five persons were killed here when lightning struck a theatre and caused those in the audience to stampede for the exits. Most of the victims were trampled to death in the rush to leave the building, which caught fire and collapsed. (H-44033.)

Loss of Life Fires, July-September, 1941.*

This is a typical rather than a complete record, presented to show the conditions under which loss of life occurs, that they may be known and guarded against. The total loss of life by fire in the United States is estimated at 10,000 annually.

Occupancy	No. Fires	Men	Women	Children	Total
Aircraft	1	0	0	3	3
Apartments, hotels, lodgings, tenements, etc.	10	11	6	2	19
Barns and stables	1	0	0	1	1
Boats and ships (except tank vessels)	3	22	17	0	39
Tank vessels	2	3	0	0	3
Dwellings—rural	12	3	6	20	29
Dwellings—urban	13	6	4	11	21
Forest and brush fires	2	2	0	0	2
Hospitals and institutions	1	0	1	0	1
Manufacturing occupancies	7	12	0	0	12
Mercantile occupancies	1	1	0	0	1
Mining property	2	16	0	0	16
Motor vehicles (except tank trucks)	3	8	1	1	10
Tank trucks	3	11	0	0	11
Oil refineries and bulk distributing plants	2	2	1	0	3
Out-of-door fires	2	1	0	1	2
Piers and wharves	2	37	0	0	37
Other known buildings	4	7	0	2	9
Total	71	142	36	41	219

*This table is made up from those reports received by the Department of Fire Record between June 15, 1941, and September 15, 1941. A few of the fires included herein occurred prior to June 15, but were not reported until subsequent to that date.

Typical Loss of Life Fires.

Aircraft Fire.

SEPTEMBER 2, 1941, HEMPSTEAD, N. Y. Three children were fatally burned here when an Army P39 pursuit plane plummeted to earth in flames only 25 feet from where the children were playing. Stores near by were splattered with burning gasoline and several other persons were treated for burns. (H-44054.)

Asphyxiation.

MAY 8, 1941, SEATTLE, WASHINGTON. Four persons were asphyxiated in this city when the lobby of the hotel in which they were living caught fire and sent superheated air and smoke billowing up the open stairway and through transoms of the rooms above. Twelve other persons were injured. (H-44040.)

AUGUST 22, 1941, NEW YORK, N. Y. A fire which did $50,000 worth of damage to the 4956-ton Finnish freighter *Aurora,* anchored in the Hudson River, also took the life of the ship's chief officer. He was suffocated in his bunk. Launches rescued 18 other members of the crew. (H-44050.)

Clothing Ignited.

JUNE 7, 1941, AYER, MASS. A 71-year-old worker died here from burns received when he struck a match on his oil-soaked clothing. (L-06536.)

JULY 2, 1941, ANTHONY, KANS. A six-year-old boy in this town received fatal burns when his clothing was set ablaze while he played near a grass fire. The boy's father was severely burned extinguishing the fire. (L-06548.)

AUGUST 28, 1941, SAN JOSE, CALIF. Three men died after their clothing had been set afire by 200 pounds of burning magnesium. The fire occurred in an experimental process in a newly constructed defense plant. (H-44051.)

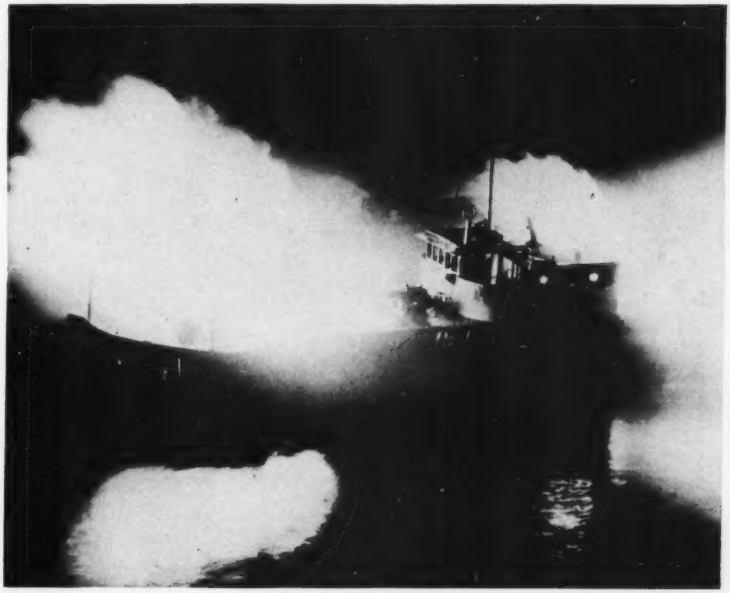
Explosion.

JUNE 15, 1941, KANSAS CITY, KANS. Two workmen were killed and eight others were injured when an explosion occurred in a drainage district pump house. It is believed that the explosion was from sewer gas. (H-44043.)

Causes of Loss of Life, July-September, 1941.

Fatalities classified according to the immediate cause of the loss of life rather than according to the cause of the fire.

Cause of Fatality	Men	Women	Children	Total
Aircraft fires	0	0	3	3
Asphyxiation (smoke and gas suffocation)	8	4	3	15
Clothing ignited:				
1. Bonfires, burning rubbish, etc.	0	0	2	2
2. Furnaces, stoves, and heaters	0	1	0	1
3. Smoking and matches	2	0	0	2
4. Miscellaneous	3	0	0	3
Entering a burning building	0	0	2	2
Escaping fire; jumped, fell or drowned	34	1	1	36
Explosions:				
1. Chemicals	8	0	0	8
2. Electrical transformers and switches	4	0	0	4
3. Fireworks	0	0	4	4
4. Manufactured and natural gases	0	1	0	1
5. Miscellaneous and unknown	3	0	0	3
Fire fighting—firemen	3	0	0	3
Fire fighting—civilians	1	0	0	1
Flammable liquids and vapors:				
1. Gasoline and similar liquids:				
(*a*) Miscellaneous	1	0	0	1
2. Kerosene, range oil, and fuel oil:				
(*a*) Stoves, lamps, and torches	1	0	0	1
(*b*) Used to kindle fire	2	2	2	6
3. Petroleum production and storage	2	1	0	3
Forest and brush fires (including fire fighting)	1	0	0	1
Marine fires	24	17	0	41
Mine fires and explosions	16	0	0	16
Motor vehicle fires (except tank trucks)	8	1	1	10
Tank trucks	11	0	0	11
Trapped in burning buildings	10	7	23	40
No data	0	1	0	1
Total	142	36	41	219



International.

Five minutes after leaving its Detroit dock loaded with 750,000 gallons of gasoline, the Canadian tanker "Transiter" burst mysteriously into flames which took the lives of two persons, one of them the wife of the captain. Although the fire is attributed to an electric spark, the Federal Bureau of Investigation is concerned because gasoline is so important to defense.

Fire Fighting.

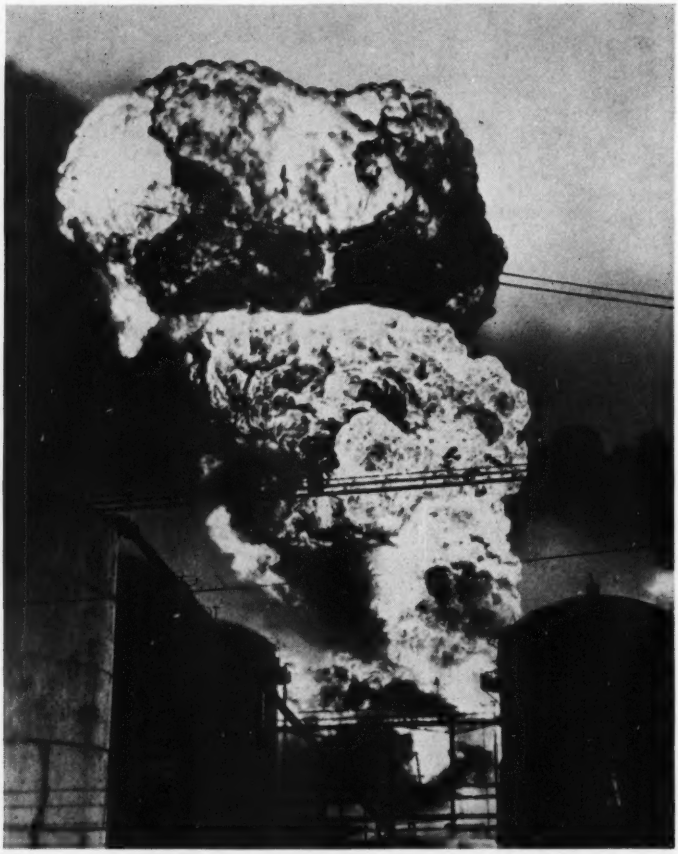
APRIL 11, 1941, WILTON, N. Y. A professor of agriculture perished in a brush fire on his farm in this town. The fire swept over eight acres before it was finally brought under control. (L-06524.)

MAY 12, 1941, NEW BRITAIN, CONN. One fireman died and three others were overcome as they ran a hose line through thick smoke in an attempt to extinguish the fire at the source. (L-06531.)

Fireworks.

JULY 4, 1941, KANSAS CITY, KANS. An aerial bomb set off by a pyrotechnician misfired and shot along the ground for 75 feet, exploding, finally, among a group of spectators. A child of four was killed and ten other persons were severely injured. (L-06549.)

JULY 4, 1941, MEMPHIS, TENN. Two youths lost their lives on the outskirts of this city when a lighted firecracker was thrown into a stand where fireworks were sold. Although the sale of fireworks is banned in Memphis, they are not banned in the surrounding towns, and the stand where the tragedy occurred was just over the city lines. (L-06550.)



Acme.

One was killed and five were injured, and thousands of gallons of aviation gasoline for defense were turned to flames when fire from an unknown cause swept through the world's largest refinery in Whiting, Indiana, September 24.

Kerosene Used to Kindle Fire.

MAY 1, 1941, CIMARRON, KANS. A father and his seven-months-old baby died from burns received when three gallons of kerosene was thrown on the smoldering coals of a kitchen fire. Another child in an adjoining room was not injured by the explosion. (L-06527.)

JUNE 19, 1941, CLYDE, KANS. Two women and a baby were fatally burned when kerosene which was being poured into a kitchen range exploded. (L-06542.)

Fires and Fire Losses Classified, 1940.

Continuing the practice begun four year ago of showing the distribution of the annual fire loss in the United States by cause and occupancy classes, the N.F.P.A. Department of Fire Record presents the following tables covering the year 1940. Experience of the past years shows that these estimates are widely used in fire prevention and fire protection work.

The data upon which these tables are based were obtained from fourteen state fire marshals' reports for the year 1940, or the closest fiscal year thereto. Reports of these particular states were chosen because they contained the most complete classifications.* While methods of reporting and tabulating fire loss figures are different in each state, it is believed that the volume of statistics from the fourteen typical states included herein is sufficiently large to indicate the relative distribution of fires and fire losses for the various occupancies and causes.

Tables I to IV are tabulations made from fire marshals' reports. Table I shows the number of fires, and Table II shows the fire loss by occupancies reported for the year 1940 in the fourteen states. Tables III and IV show the number of fires and losses distributed according to causes. The general classes making up both the occupancy and cause classifications were carefully chosen with regard to good practice and to classes most commonly used in the reports. Tables V to VII are recapitulations and estimates for the entire United States based upon the first four tables and adding a certain percentage to cover unreported fires and losses as explained below.

Table V is a recapitulation of the state totals presented in the foregoing tables, with columns added to show the number of fires per thousand population and the fire loss per capita. It will be observed that a total of 103,581 fires were reported in 1940 for the group of fourteen states having a total population of 37,714,063 in the 1940 census. A study of the best data available indicates that this number of fires is approximately half the actual number of fires for the year, and therefore 100 per cent has been added to get the estimate for the fourteen states. When the resulting figure is applied to the whole country at the population ratio, the estimated number of fires in the United States in 1940 is 725,000. This makes 5.50 fires per thousand population as compared with 5.24 in 1939 (October, 1940, QUARTERLY, page 149).

The estimated fire loss of $290,000,000 in the United States in 1940 was obtained by applying the population ratio to the total loss in the fourteen states and adding 30 per cent to cover unreported losses. This figure is

*The State of Connecticut, reporting for the first time this year, presented very detailed data, but was not included because of lack of time to tabulate the figures.

Table I. Number of Fires by Occupancies in Fourteen States — 1940.

Occupancy	Illinois	Indiana‡	Iowa	Kansas	Massachusetts	Nebraska	North Dakota†	Ohio	Oregon*	South Dakota†	Vermont	Washington	West Virginia	Wisconsin	Total
I. PUBLIC BUILDINGS															
Government buildings	1	20	....	....	37	3	7	....	10	1	4	....	1	18	102
Hospitals, institutions	16	2	5	2	10	3	....	43	....	3	6	2	1	19	112
Schools	71	31	28	16	34	12	4	56	27	7	15	22	9	76	408
Churches	80	35	19	19	35	8	4	107	12	7	8	11	1	61	407
Theatres	27	10	16	5	8	10	5	36	21	7	6	12	3	19	185
Amusements, halls	82	31	14	....	90	3	....	106	....	11	13	28	1	74	453
II. DWELLING OCCUPANCIES															
Hotels, boarding houses	387	24	36	7	204	21	41	102	315	20*h*	26	230	4	130	1,547
Apartments, rooming houses	2,212	104	159	....	....	34	....	1,600	....	10	3	309	7	214	4,652
Dwellings	6,481	3,644	2,445	1,477	5,305	850	695	11,978	5,027	381	1,249	3,332	317	11,818	54,999
III. MERCANTILES															
Office bldgs., includ'g banks	166	49	33	....	205	19	....	221	....	10	....	16	6	47	772
Restaurants, taverns	291	69	83	....	138	39	....	....	80	....	4	97	4	333	1,138
Barber, beauty shops	36	....	16	....	8	12	....	....	....	....	....	11	....	26	109
Misc. mercantiles	1,358	255	243	528*b*	1,052	162	272	1,256	573*b*	....	239	297	40	503	6,778
Warehouses	93	68	72	....	163	22	....	303	41	104	1	22	9	101	999
IV. MANUFACTURING															
Metal workers	50	12	7	3	2	1	1	....	19	....	....	2	....	16	113
Woodworkers	5	....	2	....	9	....	....	....	86	....	12	8	....	9	131
Flour mills, elevators	91	14	52	5	....	21	16	....	8	7	4	7	....	42	267
Packing plants, stockyards	....	22	3	....	37	....	6	....	....	....	....	5	....	....	73
Bakeries	34	3	5	....	52	6	....	....	....	....	....	9	2	13	124
Laundries	40	13	6	10*c*	....	9	....	43	....	....	2	7	....	13	143
Cleaners, tailors	30	13	12	....	24	....	....	22	....	4	1	20	7	19	152
Misc. manufacturing	415	184	77	10	420	25	17	797	149	2	25	39	21	377	2,558
V. MISCELLANEOUS															
Barns	482	350	271	381*d*	167	....	207	558	319*g*	96*g*	673*d*	78	25	575	4,182
Outbuildings	937	259	193	....	263	131	....	596	....	....	3	42	6	324	2,754
Lumber yards	15	14	9	2	13	5	....	33	....	3	3	22	....	11	130
Railroads, wharves	95	24	11	10	53	....	....	....	....	6	....	....	1	83	283
Bulk oil storage, refineries	114	5	1	33*e*	....	....	7	....	23	....	....	1	....	....	184
Garages, filling stations	1,036	360	294	4*f*	288	158	21	1,532	41	75	30	87	17	430	4,374
Power plants, pump houses	10	9	11	....	5	....	....	....	38	3	3	2	....	44	125
Creameries, dairies	....	7	22	....	....	3	2	....	....	3	2	16	....	26	81
Miscellaneous structures	392	73	130	....	135	93	20	1,620	....	4	8	340	7	118	2,940
Motor vehicles, inc. aircraft	1,907	388	531	175	890	144	....	3,476	798	80	....	....	11	2,239	10,639
Fires other than structures	253	41	81	....	42	....	1	312	....	22	....	11	2	895	1,650

*Number of insurance claims, not number of fires.
†Fiscal year ending June 30, 1941.
‡Fiscal year ending June 30, 1940.

a. Does not include farm property.
b. Includes office buildings.
c. Includes cleaners.
d. Includes all farm property.
e. Includes filling stations.
f. Includes airplane hangars.
g. Includes outbuildings.
h. Includes restaurants.

Table II. Fire Loss by Occupancies in Fourteen States — 1940.

Occupancy	Illinois	Indiana‡	Iowa	Kansas	Massachusetts	Nebraska	North Dakota†	Ohio	Oregon	South Dakota†	Vermont	Washington*	West Virginia	Wisconsin	Total
I. Public Buildings															
Government buildings	$90	$36,248	....	....	$52,213	$5,100	$19,565	....	$943	$600	$8,799	....	$1,500	$4,859	$129,917
Hospitals, institutions	26,110	504	$1,130	$20	10,020	1,825	....	$39,736	....	235	6,026	$3,254	250	2,065	91,175
Schools	210,387	42,919	214,887	19,907	114,774	67,403	20,686	30,324	190,230	42,054	77,982	115,975	22,000	151,126	1,320,474
Churches	322,994	54,762	66,105	118,044	138,914	25,825	1,755	192,227	4,961	30,672	3,664	6,332	100	81,793	1,048,148
Theatres	62,358	2,913	46,181	3,771	11,095	10,658	302	5,577	4,842	30,308	26,130	3,480	13,200	20,603	241,418
Amusements, halls	122,680	27,930	33,711	....	170,904	16,520	....	61,606	....	6,544	7,911	5,689	300	66,825	520,620
II. Dwelling Occupancies															
Hotels, boarding houses	140,601	9,277	59,152	4,060	194,515	59,412	29,964	16,061	39,790	4,177*h*	215,896	31,642	1,375	232,210	1,038,132
Apartments, rooming houses	363,924	126,006	66,844	....	....	10,081	....	262,195	....	1,391	1,872	53,621	1,875	29,560	917,369
Dwellings	3,270,902	1,968,054	1,424,436	469,337	4,278,283	532,204	101,330	2,969,085	976,920	185,487	300,563	1,286,075	108,240	2,501,500	20,372,416
III. Mercantiles															
Office bldgs., includ'g banks	147,002	32,950	35,205	....	944,140	6,338	....	55,280	....	8,904	....	5,035	21,400	17,451	1,273,705
Restaurants, taverns	248,632	51,277	75,158	....	255,015	30,975	....	....	24,142	....	1,725	23,912	3,350	193,702	907,888
Barber, beauty shops	24,088	....	8,317	....	5,696	4,047	....	....	....	....	....	5,001	....	1,415	48,564
Misc. mercantiles	1,241,004	870,511	711,348	1,114,966*b*	2,220,813	507,905	405,200	1,217,855	452,816*b*	....	269,116	211,576	147,725	499,639	9,870,474
Warehouses	238,259	987,706	269,122	....	872,495	67,159	....	421,494	157,476	265,763	44,540	88,182	10,980	279,281	3,702,457
IV. Manufacturing															
Metal workers	12,012	52,058	11,045	1,067	7,483	2,100	19	....	7,444	....	....	276	....	24,812	118,316
Woodworkers	9,950	....	275	....	32,581	....	....	....	237,291	....	113,883	10,011	....	30,513	434,504
Flour mills, elevators	617,715	149,623	184,480	24,880	....	102,977	65,332	....	38,713	155,828	10,995	19,143	....	84,121	1,453,807
Packing plants, stockyards	....	54,142	4,960	....	26,475	....	4,023	....	....	....	....	2,745	....	....	92,345
Bakeries	11,495	1,355	825	....	48,439	2,094	....	....	....	....	....	756	175	5,446	70,585
Laundries	95,324	18,421	14,513	1,165*c*	....	25,405	....	18,018	....	....	7,365	11,485	....	2,564	194,260
Cleaners, tailors	11,393	8,432	20,082	....	13,954	....	....	68,471	....	4,122	26	6,335	11,800	5,515	150,130
Misc. manufacturing	587,543	466,077	225,013	34,946	1,749,352	21,746	5,675	1,501,291	1,178,800	346	37,205	98,547	106,992	428,672	6,442,205
V. Miscellaneous															
Barns	884,557	527,491	549,770	499,937*d*	307,945	....	87,639	827,950	215,557*g*	74,790*g*	579,348*d*	67,048	16,605	784,349	5,422,986
Outbuildings	169,840	179,136	53,486	....	69,017	30,429	....	105,791	....	....	3,009	25,936	1,660	73,428	711,732
Lumber yards	314,519	39,310	90,868	12,300	66,130	15,522	....	208,868	....	15,245	4,781	362,141	....	12,999	1,142,683
Railroads, wharves	70,871	38,392	20,286	387,675	74,452	....	....	....	....	2,367	....	....	....	19,470	613,513
Bulk oil storage, refineries	183,134	3,275	850	66,891*e*	....	....	3,164	....	12,121	....	....	558	....	....	269,993
Garages, filling stations	440,245	94,378	150,782	6,395*f*	215,387	102,354	13,654	320,026	28,836	47,052	20,918	38,541	9,598	173,466	1,661,632
Power plants, pump houses	24,481	3,235	9,993	....	275,844	....	....	....	86,965	3,291	605	203	....	35,053	439,670
Creameries, dairies	....	16,765	3,962	....	....	208	95	....	....	2,220	3,133	20,658	....	11,967	59,008
Misc. structures	617,971	37,139	63,752	....	59,974	39,809	12,011	845,736	....	3,675	5,368	565,905	....	50,000	2,301,340
Motor vehicles, inc. aircraft	133,130	78,559	28,250	34,167	61,054	89,499	....	123,911	57,455	6,726	....	....	12,500	153,725	778,976
Fires other than structures	35,462	123,515	4,433	....	160,052	....	35	5,572	....	2,466	....	2,774	6,500	66,192	407,001

*Insurance losses only.
†Fiscal year ending June 30, 1941.
‡Fiscal year ending June 30, 1940.
a. Does not include farm property.
b. Includes office buildings.
c. Includes cleaners.
d. Includes all farm property.
e. Includes filling stations.
f. Includes airplane hangars.
g. Includes outbuildings.
h. Includes restaurants.

Table III. Number of Fires by Causes in Fourteen States — 1940.

Causes	Illinois	Indiana‡	Iowa	Kansas	Massachusetts	Nebraska	North Dakota†	Ohio	Oregon*	South Dakota†	Vermont	Washington	West Virginia	Wisconsin	Total
Chimneys, flues — defective, overheated	1,278	677	349	234	780	150	65	2,284	713	71	550	252	52	1,669	9,124
Sparks on roofs	2,123	984	955	247	240	108	15	3,069*c*	384	....	40	243	2	1,098	9,508
Defective or overheated heating equipment	1,639	501	484	379	386	144	103	2,253	631	21	199	271	1	390	7,402
Rubbish	1,239	322	....	21	174	....	3	649	14	42	17	....	4	218	2,703
Combustibles near heaters	....	30	57	....	295	....	....	....	....	....	....	99	....	428	909
Open lights, flames, sparks	483	....	12	99	137	127	32	828	114	58	50	297	2	253	2,492
Hot ashes, coals	321	407	49	161	176	23	47	558	447	15	92	73	....	307	2,676
Oil burners	....	....	21	....	458	....	....	....	....	15	....	....	....	299	793
Smoking	2,579	375	411	207*b*	2,673	133	....	4,214*b*	2,169*b*	66	358*b*	1,102	20	3,057	17,364
Children and matches	....	....	65	....	449	49	....	747	....	29	....	74	7	255	1,675
Matches	....	138	64	....	281	....	228	....	....	7	....	6	....	468	1,192
Electrical	2,132	222	208	316	1,027	171	97	2,680	505	81	99	256	20	1,629	9,443
Elec'al appliances, motors	106	193	122	14	84	16	19	318	280	20	36	46	1	649	1,904
Flammable liquids, home dry cleaning, starting fires	976	95	77	61	566	55	96	1,260	144	22	174	97	....	219	3,842
Torches, welding	....	41	56	....	79	....	....	73	....	11	....	2	....	76	338
Films	....	2	4	....	....	....	....	....	....	2	....	....	....	9	17
Lamps and stoves	....	156	81	....	....	189	....	....	....	95	....	10	23	808	1,362
Gas and appliances	110	36	5	2	15	1	14	255	....	2	4	....	4	....	448
Grease, tar, etc	146	....	41	30	155	20	31	269	393	....	37	299	....	388	1,809
Spontaneous ignition	466	155	210	70	451	84	20	693	106	34	10	58	16	273	2,646
Fireworks	44	4*a*	....*a*	20	91	7	9	53*a*	30	4	3	....	....*a*	32	297
Lightning	237	122	117	57	93	64	230	258	49	22	100	39	12	3,260	4,660
Thawing pipes	....	62	31	....	39	....	....	....	....	....	....	....	5	19	156
Sparks from machinery, friction	14	20	4	7	52	4	3	....	68	5	7	15	....	36	235
Incendiary, suspicious	68	33	24	12	371	17	13	248	37	7	3	19	22	35	909
Miscellaneous	192	204	563	3	53	47	19	1,614	120	75	19	833	1	515	4,258
Unknown	1,725	1,097	640	586	504	353	166	1,779	911	109	396	753	278	974	10,271
Explosions	359	196	9	75	60	....	21	....	81	23	28	101	8	1,030	1,991
Exposure	872	168	228	86	238	46	95	695	391	30	118	140	24	279	3,410

*Number of insurance claims, not number of fires.
†Fiscal year ending June 30, 1941.
‡Fiscal year ending June 30, 1940.

a. Fireworks limited to supervised displays.
b. Includes matches.
c. Includes sparks from stacks.

‡Fiscal year ending June 30, 1940.

c. Includes sparks from stacks.

Table IV. Fire Loss by Causes in Fourteen States — 1940.

Causes	Illinois	Indiana‡	Iowa	Kansas	Massachusetts	Nebraska	North Dakota†	Ohio	Oregon	South Dakota†	Vermont	Washington*	West Virginia	Wisconsin	Total
Chimneys, flues — defective, overheated	$731,371	$487,141	$340,880	$203,001	$598,998	$90,342	$72,639	$594,781	$186,090	$27,035	$107,599	$137,289	$46,400	$651,807	$4,275,373
Sparks on roofs	601,805	319,638	313,659	45,021	140,640	13,903	9,325	484,711c	120,779	....	16,185	98,536	250	342,172	2,506,624
Defective or overheated heating equipment	982,778	295,244	269,517	216,669	659,752	116,740	27,157	876,028	209,205	20,492	116,847	72,913	150	283,693	4,147,185
Rubbish	148,793	422,354	....	4,622	53,990	....	94	144,575	5,285	7,822	5,813	....	175	77,621	871,144
Combustibles near heaters	....	12,673	13,389	....	214,400	....	....	....	....	....	....	11,660	....	81,760	333,882
Open lights, flames, sparks	226,319	....	309	30,969	147,452	51,791	6,691	160,261	11,921	18,603	14,437	66,976	1,050	91,376	828,155
Hot ashes, coals	62,218	639,234	8,566	20,711	123,386	14,425	6,949	125,114	57,726	1,357	8,561	9,829	....	30,642	1,108,718
Oil burners	....	....	9,404	....	353,658	....	....	....	....	1,142	....	....	....	48,611	412,815
Smoking	359,938	121,489	100,490	104,048b	2,268,305	46,807	....	675,872b	254,751b	29,760	17,624b	74,303	5,915	340,054	4,432,706
Children and matches	....	....	7,952	....	213,453	13,098	....	80,431	....	2,656	....	10,315	2,425	57,702	388,032
Matches	....	35,431	12,910	....	302,333	....	67,123	....	....	803	....	48	....	33,275	451,923
Electrical	831,203	176,526	325,755	238,817	1,165,702	166,872	73,600	733,489	578,034	105,595	109,486	195,235	8,425	946,212	5,737,184
Elec'al appliances, motors	84,056	160,511	105,284	3,191	87,725	9,362	926	27,967	17,013	21,486	3,404	7,108	35	55,280	583,348
Flammable liquids, home dry cleaning, starting fires	362,689	34,217	41,084	18,368	367,041	37,060	40,597	305,271	55,858	11,500	67,823	35,844	....	46,048	1,423,400
Torches, welding	....	40,930	31,508	....	93,995	....	....	132,803	....	583	....	1,020	....	160,562	461,401
Films	....	1,310	4,842	....	....	....	....	....	....	220	....	....	....	2,906	9,278
Lamps and stoves	....	140,609	27,367	....	....	76,789	....	....	....	45,460	....	1,800	8,873	278,901	530,760
Gas and appliances	49,088	33,238	6,427	60	13,004	2,750	7,511	222,319	....	3,050	119	....	2,475	....	340,041
Grease, tar, etc.	39,556	....	35,783	3,322	103,037	26,669	4,241	79,416	20,098	....	3,903	30,745	....	45,474	392,244
Spontaneous ignition	465,784	196,339	416,473	47,444	888,979	110,919	8,469	472,495	76,704	176,168	21,018	74,388	6,475	338,846	3,300,501
Fireworks	6,943	2,925a	....a	4,355	32,044	2,640	598	5,729a	45,506	312	98	....	....a	3,377	104,527
Lightning	398,654	185,438	167,333	71,289	115,342	78,712	23,654	191,429	24,968	21,846	28,439	47,480	1,750	395,217	1,751,551
Thawing pipes	....	12,747	4,783	....	53,024	....	....	....	....	....	....	....	410	2,766	73,730
Sparks from machinery, friction	5,538	74,032	630	415	58,728	3,661	691	....	156,882	428	2,052	8,225	....	20,689	331,971
Incendiary, suspicious	38,433	24,494	63,097	3,315	1,032,839	36,583	54,526	132,696	58,550	11,585	11,560	26,429	24,430	190,737	1,709,274
Miscellaneous	158,364	90,682	109,913	115	29,259	24,401	29,862	603,958	24,667	11,008	7,701	313,151	....	98,021	2,940,704
Unknown	4,459,617	2,223,725	1,702,240	1,611,791	2,949,417	901,707	267,431	3,044,367	1,080,521	300,062	1,111,520	1,739,106	381,112	1,058,104	22,830,720
Explosions	86,900	117,397	60,685	55,331	370,513	....	5,460	....	21,843	30,130	30,742	32,051	1,175	224,459	1,036,686
Exposure	538,626	115,048	268,941	116,674	307,108	130,586	62,905	203,362	708,901	45,160	65,929	78,205	6,600	138,009	2,786,054

*Insurance losses only.
†Fiscal year ending June 30, 1941.
‡Fiscal year ending June 30, 1940.

a. Fireworks limited to supervised displays.
b. Includes matches.
c. Includes sparks from stacks.

$10,000,000 less than 1939 and $25,000,000 more than the corresponding figure for 1938.

Table VI shows the total estimated number of fires and fire losses distributed by occupancies and based on the data in the previous tables. Table VII shows similar figures by causes. These occupancy and cause classifications are not listed in any order of importance, but are grouped so that similar classes come together. Each class is broad in scope in order to reduce the number of classes to a minimum and permit the compilation of a sufficient amount of data on each to be of value. Several of the fire marshals' reports use much longer lists of occupancies and causes by subdividing the general classes shown in the accompanying tables. For example, some states divide the occupancy class "Dwellings" into "City Dwellings" and "Farm Dwellings," and the cause class "Lightning" into "Rodded" and "Unrodded."

To arrive at the estimates shown in Tables VI and VII the procedure outlined above was applied to the figures for each class in previous tables, except for those classes where data were lacking from several states. In such instances proportional increases in the total estimates were made. For example, some states did not give fires in "Barber, beauty shops," and the estimate of the total number of barber and beauty shop fires was therefore adjusted in accordance with the number of states reporting. A corresponding reduction was then made in other classes. In this particular example the "Miscellaneous" and "Mercantile" classes were reduced, as it is likely that the states not reporting barber and beauty shops used these classes for recording such fires.

Table V. Fires per 1000 Population and Fire Loss per Person for Fourteen States, 1940, as Reported by Fire Marshals.

State	Population 1940 Census	Number Fires	Fires per 1000 Population	Fire Loss	Fire Loss Per Person
Illinois	7,897,241	17,109	2.17	$10,638,673	$1.34
Indiana	3,427,796	6,239	1.82	6,125,318	1.78
Iowa	2,538,268	4,887	1.93	4,449,221	1.75
Kansas	1,801,028	2,687	1.49	2,799,528	1.55
Massachusetts	4,316,721	9,689	2.24	12,437,016	2.88
Nebraska	1,315,834	1,794	1.36	1,777,595	1.35
North Dakota	641,935	1,326	2.06	770,449	1.20
Ohio	6,907,612	24,797	3.58	9,297,074	1.35
Oregon	1,089,684	7,587	7.00	3,715,302	3.43
South Dakota	642,961	866	1.34	894,263	1.39
Vermont	359,231	2,340	6.51	1,750,860	4.87
Washington	1,736,191	5,085	2.93	3,072,656	1.77
West Virginia	1,901,974	502	2.64	498,125	2.62
Wisconsin	3,137,587	18,673	5.95	6,044,321	1.93
Total	37,714,063	103,581	2.75	$64,270,401	$1.70
Estimated U. S. Total.	131,669,275	725,000	5.50	$290,000,000*	$2.21

*30% added for unreported losses.

Table VI. Estimated Distribution of U. S. Fire Losses by Occupancies, 1940.

These estimated figures are intended to show the relative order of magnitude of fire losses by occupancies, and while they are reasonable approximations based on the experience in typical states they should not be taken as exact records for each class.

Occupancy	No. of Fires	Loss
I. PUBLIC BUILDINGS		
Government buildings	1,000	$750,000
Hospitals, institutions	700	500,000
Schools	2,800	5,400,000
Churches	2,700	4,250,000
Theatres	1,200	1,000,000
Amusements, halls	4,000	3,000,000
II. DWELLING OCCUPANCIES		
Hotels, boarding houses	10,000	4,200,000
Apartments, rooming houses	38,500	5,500,000
Dwellings	355,000	81,000,000
III. MERCANTILES		
Office buildings	7,500	7,500,000
Restaurants, taverns	11,000	5,500,000
Barber, beauty shops	1,700	500,000
Miscellaneous mercantiles	44,500	40,000,000
Warehouses	8,000	19,000,000
IV. MANUFACTURING		
Metal workers	1,500	1,000,000
Woodworkers	2,000	5,000,000
Flour mills, elevators	2,300	7,400,000
Packing plants	1,100	900,000
Bakeries	1,600	700,000
Laundries	1,200	1,400,000
Cleaners, tailors	1,200	900,000
Miscellaneous manufacturing	15,000	27,000,000
V. MISCELLANEOUS		
Barns	29,000	23,500,000
Outbuildings	25,000	4,100,000
Lumber yards	1,100	5,800,000
Railroad, wharf property	3,800	4,900,000
Bulk oil storage, refineries	1,700	2,200,000
Garages, filling stations	28,000	6,700,000
Power plants, pump houses	2,400	2,200,000
Creameries and dairies	1,000	500,000
Miscellaneous structures	23,000	11,700,000
Motor vehicles, including aircraft	85,000	3,800,000
Fires other than structures	10,500	2,200,000
Totals	725,000	$290,000,000

NOTE: As explained in the text, 100 per cent has been added in estimating the number of fires, and 30 per cent has been added to the losses to cover unreported losses.

Taking another example, seven states did not report the number of fires or amount of fire loss due to the cause "Matches." Accordingly, the estimated totals reported by the other states were increased and corresponding reductions were apportioned among the class "Smoking," under which it is assumed that the seven states probably recorded fires caused by matches.

As previously emphasized, these fire experiences are approximate estimates, but give a fair indication of the distribution of losses by occupation and cause classifications.

Table VII. Estimated Distribution of U. S. Fire Losses by Causes — 1940.

These estimated figures are intended to show the relative order of magnitude of fire losses by causes, and while they are reasonable approximations based on the experience in typical states they should not be taken as exact records for each class.

Cause	No. of Fires	Loss
Chimneys, flues—defective or overheated	58,000	$17,500,000
Sparks on roofs	62,000	11,000,000
Defective or overheated heating equipment	45,000	15,000,000
Rubbish	22,000	4,500,000
Combustibles near heaters	14,000	4,500,000
Open lights, flames, sparks	15,000	3,400,000
Hot ashes, coals	17,000	4,500,000
Oil burners	12,000	4,200,000
Smoking	106,000	18,000,000
Children and matches	21,500	2,400,000
Matches	20,000	3,100,000
Electrical	60,000	24,000,000
Electrical appliances, motors	12,000	2,300,000
Flammable liquids, misc., including home dry cleaning and starting fire	25,000	6,000,000
Torches, welding	7,500	3,700,000
Films	1,000	100,000
Lamps and stoves	20,000	4,500,000
Gas and appliances	3,500	1,800,000
Grease, tar, etc.	14,000	2,000,000
Spontaneous ignition	17,000	17,200,000
Fireworks	2,500	500,000
Lightning	30,000	7,500,000
Thawing pipes	2,000	600,000
Sparks from machinery, friction	2,000	1,700,000
Incendiary, suspicious	6,000	7,500,000
Miscellaneous	27,000	12,000,000
Unknown	66,000	95,000,000
Explosions	15,000	5,500,000
Exposure	22,000	10,000,000
Totals	725,000	$290,000,000

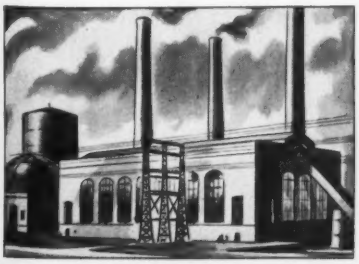
NOTE: As explained in the text, 100 per cent has been added in estimating the number of fires, and 30 per cent has been added to the losses to cover unreported losses.

FOR INDOOR USE

To protect machinery when not in use—to prevent access by unauthorized persons to tools, dies, patterns, drawings, secret documents, stores of explosives or inflammables, or other restricted areas—the A.D.T. Invisible Ray Alarm System provides effective and economical protection.

FOR OUTSIDE AREAS

Since the Invisible Ray is equally effective outdoors and in, night and day, over long and short distances, and is unaffected by rain, snow, fog or other weather conditions, it is the ideal protection for storage yards, railroad sidings, loading platforms and other outside areas. When conditions require, the beams are zig-zagged to form a network of invisible barriers over the protected area.



FOR PUBLIC UTILITIES

For power plants, gas and water works, Government establishments, oil depots, mines, etc., the Invisible Ray provides reliable and economical protection.

Defense Industries Use INVISIBLE LIGHT to trap saboteurs

The A.D.T. Invisible Ray Alarm System, employing photoelectric principles, casts beams of *invisible* infra-red light across the areas to be protected. Interruption of a beam by any person or vehicle passing through its path instantly and automatically transmits a silent alarm to the A.D.T. Central Station, guard headquarters, the police or other designated points, as well as performing other protective functions, such as sounding local alarm bells, closing doors or gates, turning on floodlights, etc.

Because of its flexibility, dependability, ease of installation and economy, the A.D.T. Invisible Ray Alarm is the ideal protection system not only for defense industries, but to supplement or minimize guard forces and other types of protection in all types of industrial, commercial and mercantile properties. For further information write to American District Telegraph Co., 155 Sixth Avenue, New York. Offices in all principal cities.

ADT

INVISIBLE RAY ALARM

One of the Services of the

NATION-WIDE A.D.T. SYSTEM

Electric Protection Against Fire · Burglary · Holdup

IN WAREHOUSES

Burglars, arsonists or others bent on removal or destruction of goods can be barred by using the Invisible Ray to "rope off" from intrusion all hazardous areas.

Fire Prevention Is A Patriotic Duty

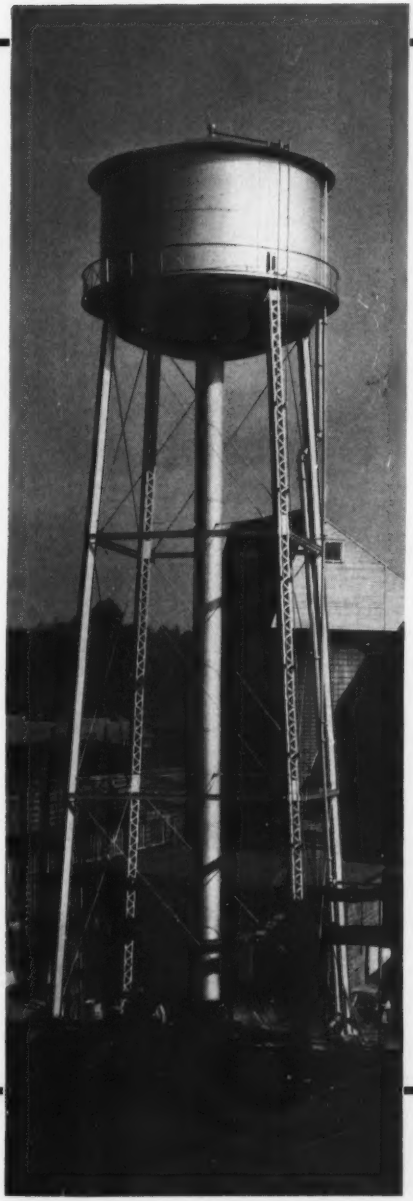
WHEN property is destroyed by fire, insurance will make good the *money* loss, but nothing can replace the *materials* that are consumed. Do your part for National Defense through Fire Defense.

The Automobile Insurance Company

The Standard Fire Insurance Company

of Hartford, Connecticut

AFFILIATED WITH THE ÆTNA LIFE INSURANCE CO.



FIRE PROTECTION FOR INDUSTRIAL PLANTS

Elevated tanks connected to sprinkler systems in buildings, or to hydrants in yards or isolated spots, give your plant the benefit of continual vigilance against fire. They are always on duty, no matter what the time of day or night. Their action is instantaneous and does not depend on personal responsibility or mechanical devices. It takes very little water to quench a fire that is just starting. That is why the quick action of gravity water pressure means so much.

Elevated tanks of ellipsoidal-bottom design are built in standard capacities and approved designs. Installations for sprinkler service usually range from 30,000 to 250,000 gallons.

CHICAGO BRIDGE & IRON COMPANY

CLEVELAND CHICAGO BIRMINGHAM
WASHINGTON BOSTON LOS ANGELES
HOUSTON DETROIT PHILADELPHIA
NEW YORK TULSA SAN FRANCISCO

can't tell Time!

A BURNING CIGARETTE STUB, sparking electric wires, inflammable fumes—are no respecters of plant routine. *Fire punches no time-card!*

A dishonest worker, a crafty hireling, a tempted office-worker—are not stopped by factory whistles. *Thieves are not on an 8-hour day!*

A foreign agent, a disgruntled employe, a paid criminal — strike when least expected. *Saboteurs take no rest periods!*

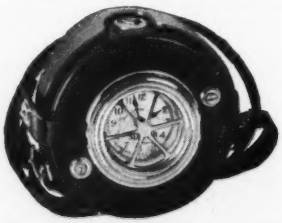
. . . *but* DETEX *counts the minutes!* The safety of your plant depends upon your watchman. A DETEX Watchclock System controls and regulates your watchman's activities, giving you a tamper-proof record of his faithfulness.

Is *your* plant receiving *complete* protection? DETEX Specialists will gladly make an expert survey of your expanding plant needs. There is no obligation, of course.

DETEX is easily installed by one of your own men, requires no wiring, no batteries. Usually pays for itself by lowered insurance premiums.

Just off the PRESS

Our 32-page booklet entitled PLANT PROTECTION FOR NATIONAL DEFENSE tells you how to counteract the triple threat of FIRE, THEFT and SABOTAGE. Contains vital information for the instruction of watchmen and guards. Write for *your* FREE copy.



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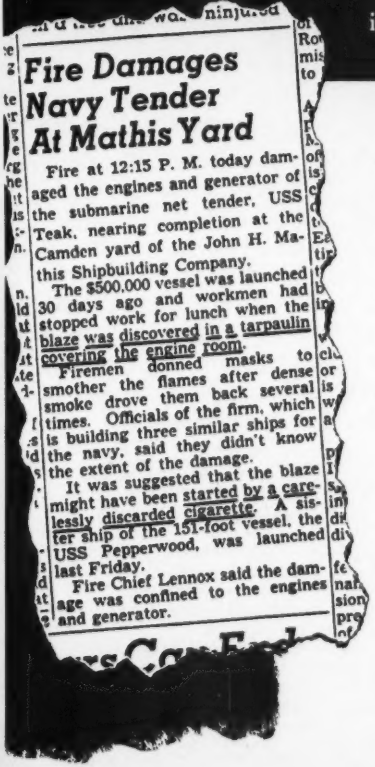
DETEX WATCHMENS CLOCKS

NEWMAN • ECO • ALERT • PATROL

Why Gamble with Fire on Important Contracts . . .

. . . where human frailty, carelessness or sabotage can destroy major investments in money and effort



Fire Damages Navy Tender At Mathis Yard

Fire at 12:15 P. M. today damaged the engines and generator of the submarine net tender, USS Teak, nearing completion at the Camden yard of the John H. Mathis Shipbuilding Company.

The $500,000 vessel was launched 30 days ago and workmen had stopped work for lunch when the blaze was discovered in a tarpaulin covering the engine room.

Firemen donned masks to smother the flames after dense smoke drove them back several times. Officials of the firm, which is building three similar ships for the navy, said they didn't know the extent of the damage.

It was suggested that the blaze might have been started by a carelessly discarded cigarette. A sister ship of the 151-foot vessel, the USS Pepperwood, was launched last Friday.

Fire Chief Lennox said the damage was confined to the engines and generator.

For a few cents more per yard, this cover could have been made of FIRE CHIEF treated canvas — with the permanent fire-resisting finish that WON'T WASH OUT — and many hundreds of dollars and weeks of production would have been saved.

Indoors or out — wherever flammable canvas presents a fire hazard, from hot rivets, welding torches, carelessly thrown cigarettes and matches, or other causes, accidental or intentional, FIRE CHIEF treated canvas will not support combustion.

Approved by the Underwriters Laboratories and the Associated Mutual Fire Insurance Companies. Meets all Government requirements.

WM. E. HOOPER & SONS CO.
New York PHILADELPHIA Chicago
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FIRE CHIEF *The Finish That WON'T WASH OUT*

Fire-Fighters Appreciate

VALVES
HYDRANTS

AND PIPE LINE ACCESSORIES

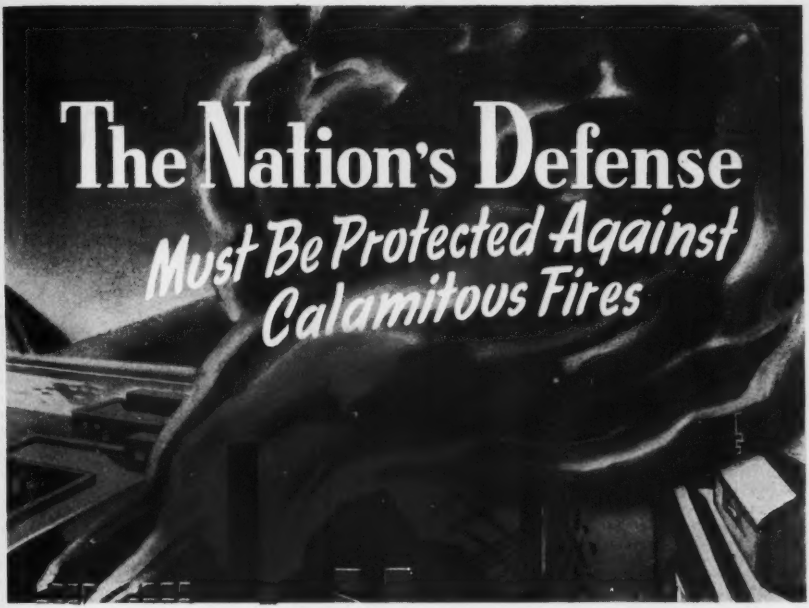
M & H products are well known for high quality material and expert workmanship. They have been widely used throughout the country for many years. They include several types of Gate Valves, Check Valves, Flap Valves, Valve Boxes, B & S Fittings, Flanged Fittings, Fire Hydrants and many other cast iron pipe line accessories.

AWWA & UNDERWRITERS APPROVED FIRE HYDRANTS

M & H Fire Hydrants are dry top and revolving head. They are easy to lubricate. Maintenance costs are low due to simplicity of design and rugged construction. They have low friction loss and great efficiency because barrel diameter is not reduced and there are no working parts or obstruction in waterway. Special Traffic model is designed to yield at the ground line under impact. Repair is simple and easy by renewing breakable bolts and breakable coupling on stem.

M&H VALVE
AND FITTINGS COMPANY

ANNISTON, ALABAMA



★ In this crisis of Unlimited National Emergency our defense production speeds ahead in the shadow of a great threat — FIRE!

Defense preparations are, invariably, extreme hazards facing the momentary danger of fire caused by accident or lurking enemy sabotage. Nothing short of all-out fire protection is adequate for any occupancy engaged in maintaining the nation's safety.

Do we count the cost of defense production? Shall we take unnecessary risks by counting too closely the cost of defense *protection?*

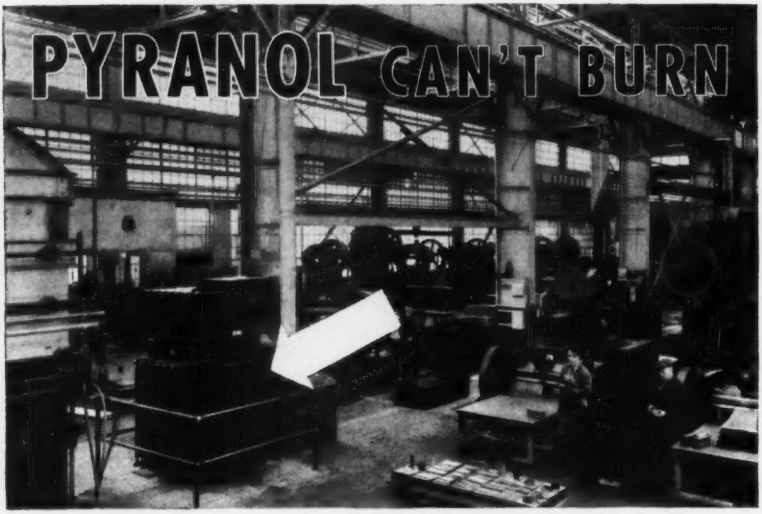
Fire Protection Engineers must answer this question in the national interest. Will they base fire protection of our defense on minimum requirements and minimum peace-time cost? Or, will they stand on their sound recommendations for full, absolute protection in the solemn determination that calamitous fires must not occur?

Will they demand that water supply be fully adequate to prevent raging fire? Will they demand that open sprinklers in quantity be ready to discharge a full-fighting deluge of water when emergency strikes? How insignificant are these costs in the face of possible disastrous loss!

Ask for Bulletin 44 on the
Suprotex-Deluge Sprinkler System

"AUTOMATIC" SPRINKLER CORP. OF AMERICA

YOUNGSTOWN, OHIO • ***Offices in Principal Cities***



RECOMMEND PYRANOL TRANSFORMERS FOR

ALL INDOOR

INSTALLATIONS

PYRANOL*, a noninflammable insulating and cooling liquid, provides transformers with extra protection against fires from internal arcing, also against external fires. That's why the Underwriters' Laboratories approve Pyranol and why the National Electrical Code permits the installation of Pyranol transformers indoors without expensive fireproof vaults as previously required.

Recommend Pyranol Transformers for Safety with Savings
Plant managers and engineers will be glad to use Pyranol transformers because they can be installed right where the power is needed—on the floor next to the job, on a beam, or even on the building roof. Floor space is conserved; secondary copper leads don't have to be carried from a distant point.

Get Complete Information
Remember — Pyranol can't burn. For additional information write for Bulletin GEA-2637. Address General Electric Company, Schenectady, N. Y.

*Reg. U.S. Pat. Off.

GENERAL ELECTRIC

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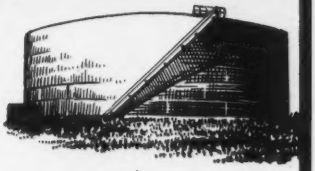
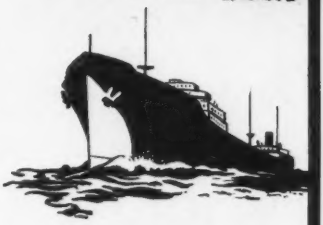
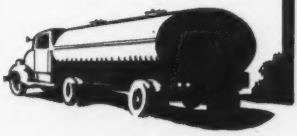
FIRE SAFEGUARDS FOR GASOLINE STORED OR IN TRANSIT!

DYNAMITE in the hands of a blasting expert is comparatively harmless. Gasoline, properly stored and transported, is in the same category. Most large oil companies use every precaution to assure the fire safety of the gasoline they store or transport. It has been our privilege to supply many of the largest refiners and marketers with fire safety devices.







Write

WE are always happy to send our catalogs to fire prevention authorities so that they may be kept abreast of the latest developments in safety equipment.

SHAND & JURS CO.

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Your copy of this bulletin will be sent on request.

TYDEN PRESSURE MAINTENANCE

. . . an AUTOMATIC device that POSITIVELY maintains PROPER air pressure in the sprinkler system

ACCEPTED by insurance underwriters, this TYDEN device is the *only* one available today that maintains positively at all times the proper amount of air pressure in dry pipe sprinkler systems. High air pressure is not only undesirable but is extremely detrimental to the operation of the system . . . the TYDEN Pressure Maintenance Device receives air from any constant source at any pressure higher than maximum required, and automatically delivers and maintains the proper pressure in the sprinkler system. Eliminates possibility of human or mechanical errors. Minimizes claims for fire or water damage. Pays for itself many times in maintenance costs. Talk it over with your VIKING man.

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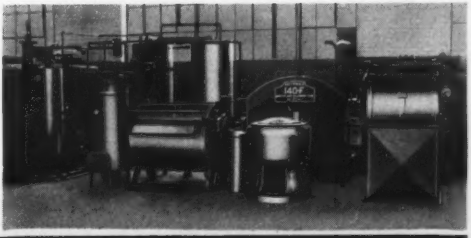
COLD FACTS ABOUT 140·F SAFETY DRY CLEANING

140·F IS A CLASS II UNIT THAT COMPLIES WITH STANDARDS OF N. B. F. U. PAMPHLET NO. 32

What's remarkable about that? Just this! The 140-F is NOT a chlorinated solvent dry cleaning unit. It's the original Safety Petroleum Solvent System — an exclusive development of the U. S. Hoffman Machinery Corporation. It has the operating advantages and economy features that dry cleaners want, yet it is an Approved System that has made a distinct contribution to safety in the dry cleaning industry.

USES 140° FLASH PETROLEUM SOLVENT

The Hoffman 140-F dry cleaning system employs safety petroleum solvent with flash point of approximately 140°F. It has many unusual features, including a drying tumbler from which all vapor is expelled at safe temperatures before tumbler can be opened.



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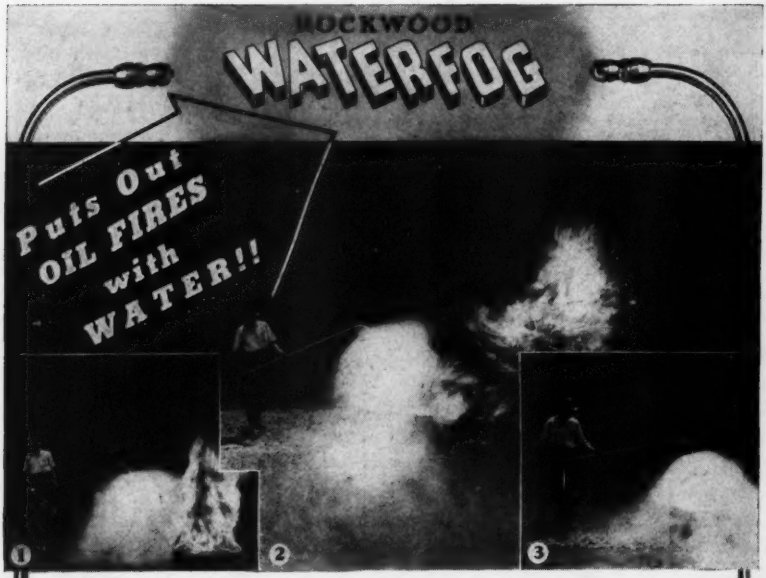
EQUIPMENT FOR EVERY DEPARTMENT OF THE DRY CLEANING PLANT



This new fire fighting weapon gives **ordinary water** remarkable new extinguishing power. It instantly turns water into *low velocity* WATERFOG — a powerful new extinguishing agent that puts out fires so rapidly that it will startle you!

By the use of ordinary water, generated into WATERFOG . . . small fires in flammable liquids can *now* be cut down quickly and cleanly, without the use of expensive chemicals — with minimum water damage.

For those plants desiring protection of dip or oil storage tanks, dryers, transformers and other types of hazards involving flammable liquids or materials—Rockwood engineers have designed fixed piping installations that will give these hazards the most effective fire protection.

Send for our new descriptive ROCKWOOD WATERFOG booklet.

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In Canada: WORCESTER-ROCKWOOD, LTD., Montreal and Toronto.

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PROPERTY CREATED BY YEARS OF INDUSTRY IS DESTROYED BY FIRE IN AN HOUR as the result of only a slight delay in sending an alarm.

Three-Fold
Fire Alarm Box

Fire is the greatest destroyer of property, and DELAY due to inadequate facilities for transmitting alarms to the fire department is the greatest accelerator of the flames.

A reliable Fire Alarm Telegraph System with adequate box distribution protects property, gives the fire department a chance to keep losses small, and relieves the community as a whole from the responsibility for fire waste due to DELAYED ALARMS.

Surveys, plans, and estimates furnished without cost or obligation.

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Newton Upper Falls, Massachusetts

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National Defense calls for the conservation of vital raw materials and their diversion, in whole or in part, to safeguarding America and democracy throughout the world. And so, Priority or precedence in obtaining such materials is granted by the Government to those engaged in filling the requirements of this great defense program.

Priority in the extinguishment of fire was established by Grinnell Automatic Sprinkler Systems more than half a century ago. And today they are still recognized as the world's most modern and efficient automatic fire protection agency in industrial, commercial and institutional buildings.

There is a type of Grinnell Sprinkler System for every fire hazard. Each is designed to provide the utmost in automatic fire protection for specific conditions. Complete information is available for the asking from any of our offices throughout the country. Grinnell Company, Inc., Executive Offices, Providence, R. I.

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AUTOMATIC SPRINKLER FIRE PROTECTION